THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. VI. No. 126—9th YEAR.] LONDON, AUGUST 18, 1857. [Subscription per Ann. 15s. in Advance 18s. Credit.] Price 6d. Unstamped.

CANNEL COAL.

RAMSAY'S NEWCASTLE CANNEL was discovered by the Advertiser in 1818. Cannel Coal was then little used in London: after surmounting much opposition, it has become the principal Cannel Coal used in the Metropolis, and has greatly assisted in improving the London gas. Its joint products of gas of high illuminating power, and coke of good quality, make it one of the most economical coals known. It is used by all the London Gas Companies, as well as by many Provincial and Foreign. The Crystal Palace was lighted from it in 1851, and the Post-office, Bank, and *Times* Office, are at present.

FIRE-CLAY RETORTS.

FIRE-BRICKS of all descriptions. Manufactory established in 1804.

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Bone and Artificial Manures of all kinds.

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April 27, 1854.

OLDHAM CORPORATION.
GAS AND WATER WORKS DEPARTMENT.

THE Oldham Corporation are prepared to appoint persons to fill the undermentioned situations:—

A Chief Clerk, to take the entire management of the office department for the Gas and Water Works. He will be required to devote the whole of his time to the duties of his office. The salary will be £250 per annum. Security to the amount of £2000 will be required.

A Manager for the Gas-Works, who will have to superintend the Manufacture of Gas at all the stations. He will have to devote the whole of his time to the duties of this situation. The salary will be £200 per annum, with a house, including coals, gas, and water.

A person to superintend the men engaged in laying the Gas and Water Mains and Service-Pipes, and all other outdoor men employed in the distribution of Gas and Water. He will be required to devote the whole of his time to the service of the Corporation. The salary will be £100 per annum.

Information more in detail may be had on personal application to the undersigned, at the Gas and Water Works Office, in OLDHAM.

Satisfactory Testimonials as to character and qualifications will be required.

Applications to be made in writing under sealed cover, with Testimonials enclosed, to the Chairman of the Gas and Water Works Committee, on or before Saturday, the 22nd of August inst.

GEO. EMMOTT, Engineer.

Oldham, Aug. 10, 1857.

THE Directors of the Daventry GASLIGHT COMPANY are prepared to receive Tenders for a NEW GASOMETER, and BRICK TANK for the same; the Holder to be 32 feet diameter, by 10 feet deep. Plans and specifications may be seen by applying to the Superintendent of the Gas-Works, to whom tenders for the same must be sent (sealed) before the 29th instant. The whole to be completed by the 1st of December next. The directors do not pledge themselves to accept the lowest tender.

Daventry Gas-Works, Aug. 15, 1857.

WILLIAM STEPHENSON & SON,
THROCKLEY,
NEWCASTLE-ON-TYNE,

MANUFACTURERS OF EVERY DESCRIPTION OF

FIRE BRICKS, CLAY RETORTS, LUMPS, TILES,

&c. &c.

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A large stock of Fire-Clay Goods always on hand in London, at the lowest wharf prices, at Messrs. CHRISTIE and Co.'s Wharf, 64, Bankside, SOUTHWARK.

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PURIFIERS, &c.—To be disposed of, FOUR DRY LIME PURIFIERS, 6 feet square, inside measure; 4 tiers of grids to each, with apparatus for raising Covers, and Centre Valve, with 9-inch Connexion Pipes; the whole complete, and in good condition, being taken down to be replaced with larger. Also, a CENTRE VALVE, for 2 Purifiers, with 8-inch Connexions.

For further particulars, application to be made to,
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BRYAN DONKIN and CO.'s improved GAS VALVES have been adopted by numerous Gas Companies in England and abroad, and their advantages and great security fully proved. Very large numbers are in use. Prices from 11s. 6d. to 13s. 6d. per inch diameter.

BRYAN DONKIN and Co.,
Engineers, near Grange Road, BERMONDSEY.

COWEN'S PATENT FIRE-CLAY RETORTS.

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BLAYDON BURN, NEAR NEWCASTLE-ON-TYNE.

Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS RETORTS and OTHER OBJECTS in FIRE CLAY."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire Clay Retorts in the United Kingdom; and orders for Fire Clay Retorts of all shapes and dimensions, Fire Bricks, and every other article in Fire Clay, are promptly executed at their works as above.

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Coal and Coke Office,
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FIRST PRIZE IN THE PARIS EXHIBITION.

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THE OLD TUBE WORKS,
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and 69, UPPER THAMES STREET, LONDON,

Original Manufacturers of Wrought-Iron Gas Tubes, and Holders of the present Patents; Inventors and First Makers of LAP-WELDED FLUES for Steam Boilers.

J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water, and the largest Orders may be executed in a few days.

The eminent Engineer, Mr. Perkins, confines himself altogether to the use of John Russell and Co.'s Tubes in his High-Pressure Steam Patents.

Gun Metal, and all other kinds of Cocks, Stocks, Dies, and Taps, Galvanised Tubes, &c.

N.B. All Goods thoroughly Tested before sent out, and Warranted.

WANTED, for a small Country GAS-WORK, a competent man to take the entire MANAGEMENT of the WORKS, with a subordinate assistant. Wages, 20s. per week, with use of cottage on the works, coals and gas. Application, with Testimonials, to be addressed to Mr. JOSEPH BARKER, gas engineer, Framlingham, SUFFOLK.

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MANUFACTURERS OF WET GAS-METERS,
35, BRITANNIA STREET, CITY ROAD,
LONDON.

N. B. These Meters have the Adjusting Slide and Hydraulic.

OLD METERS REPAIRED.
Established Thirty Years.

WANTED, by a person 26 years of age, a Plumber and Gasfitter by trade, a Situation as INSPECTOR. Good references, and security can be given. Address, G. J., 3, Cumming Street, PENTONVILLE, N.

FOR SALE, 1000 yards of 3-inch GAS MAIN, 600 yards of which is turned and bored; and TWO 3-inch SYPHONS. The whole is in good condition, having only been in use four years. For further particulars apply to Mr. D. MURPHY, Gas Contractor, Hythe, KENT.

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MANUFACTURERS OF DINAS FIRE BRICKS AND RETORTS,

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Beg to draw the attention of the Engineers and Managers of Gas-works to the superior quality of their goods, and more especially to their BRICK RETORTS, which, in addition to the almost infusible nature of the Fire-Clay employed, have the great advantage, from its large excess of Silica, of EXPANDING BY THE APPLICATION OF HEAT, and consequently becoming sounder and less liable to leak by use. Their cost is less than that of the ordinary Clay Retorts.

Young and Allen's DINAS FIRE-BRICKS and CEMENT have been long used for the linings of furnaces exposed to high temperatures, and are well known in the London and other Gas-works. They can be forwarded by rail to all parts of the United Kingdom, and shipped by sea to all parts of the world.

Prices on application as above.

BLAYDON BURN AND LOW BENWELL FIRE-CLAY RETORT AND FIRE-BRICK WORKS, NEAR NEWCASTLE-ON-TYNE.

WILLIAM COCHRAN CARR,

begs most respectfully to thank the Metropolitan, Provincial, and Continental Gas Companies for their patronage for several years past, and to intimate that he has rebuilt and enlarged his extensive premises for the Manufacture of CLAY RETORTS; and that he is now prepared to execute the largest orders with punctuality and despatch. Orders for FIRE-CLAY RETORTS, of all shapes and sizes, FIRE-BRICKS, and all other Articles in Fire-Clay, executed on the shortest notice and on the most reasonable terms.

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WOLVERHAMPTON PATENT WROUGHT-IRON TUBE WORKS,
Originally established in 1833,

Manufacturer of Gas and other Tubes, Fittings, and articles of every description belonging to Gas, Water, or Steam.

E. D. had the honour of receiving the

PRIZE MEDAL

awarded to this Manufacture by the COUNCIL of the GREAT ENGLISH EXHIBITION of 1851; and from the latter date has supplied many towns exclusively with GALVANIZED and other Tubes for Gas and Water, under GOVERNMENT ENGINEERS.

A City, containing 150,000 inhabitants, has recently been entirely supplied with Tubes made at the above-named Works, and several others with populations nearly as great; in fact, the reputation now acquired induces this notice to the public.

Large Stocks generally on hand, averaging from one to three hundred thousand feet.

HYDRAULIC PRESS TUBES,

to resist 6000 lbs. and upwards to the square inch, extensively manufactured.

STOCK DYES and SCREWING TACKLE,

of the best possible description.

Every Tube carefully tested with Hydraulic Pressure before leaving the Works.

EIGHTON MOOR GAS COALS.—Parties wishing to be supplied with these first-class Gas Coals will please to apply to Mr. MATTHEW NESBIT, EIGHTON MOOR OFFICE, NEWCASTLE-UPON-TYNE. These coals are well known as among the richest in gas, and working the roundest on the River Tyne. They are extensively used by metropolitan gas works.

HARRIS AND PEARSON,

PROPRIETORS OF

BEST CLASS-HOUSE POT AND CRUCIBLE CLAY

MANUFACTURERS OF

FIRE BRICKS GAS RETORTS, &C.

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Late in the occupation of I. and W. King.
Originally J. Pidcock, Esq.

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PATENT GAS METER & APPARATUS WORKS,
GRAY'S-INN-ROAD, LONDON,

Manufacturers of WET and DRY GAS METERS, STATION METERS, GOVERNORS, EXPERIMENTAL APPARATUS, GAS STOVES, and LANTERNS.

Contractors for the erection or alteration of Gas Works; and every description of Apparatus required in Gas Works supplied.

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JAMES FERGUSON and CO., Lessees of the Auchinheath and Craignethan Gas Coalfields (the most extensive and valuable in the parish of Lesmahago), respectfully intimate to the Managers of Gas Works and Consumers of Gas Coal, that he is prepared to ship the best quality of the above well-known COALS at Glasgow or Leith; and also to deliver them at the railway stations upon, or connected with, the Caledonian Railway, to any extent which may be required.

Price, free on board, or delivered at the railway stations, may be learned by addressing James Ferguson and Co., Gas-Coal Works, Lesmahago; or J. H. Jones, 1, Poets'-corner, Westminster, sole Agent for London.

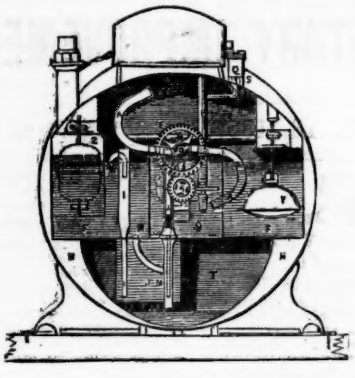
Shipping Agent for Glasgow:
MR. ALEXANDER STRATTON,
159, WEST GEORGE STREET.

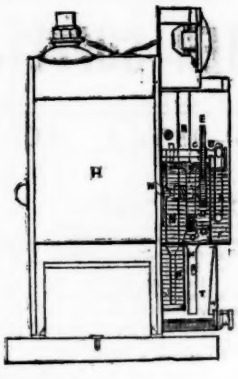
JOURNAL OF GAS LIGHTING ONE PENNY NEWSPAPER

CROSLEY & CO.,

GAS-METER MANUFACTURERS,

103, SOUTHWARK BRIDGE ROAD, LONDON.





SOLE LICENCEES AND MANUFACTURERS OF

W. CROSLEY'S AND CROSLEY AND GOLDSMITH'S

PATENT STANDARD SELF-ADJUSTING AND COMPENSATING GAS-METERS,

By which the True Water-Line is constantly maintained, and accuracy of measurement at all times secured. SEVERAL THOUSANDS OF THEM HAVE BEEN FIXED, AND ARE NOW AT WORK, and numerous Testimonials from eminent Gas Engineers, expressive of their approbation of them, may be seen at the Manufacturers'.

Manufacturers of LOWE'S PATENT MOTIVE-POWER METER, for situations where there is an inadequacy of pressure to supply the special requirements of certain consumers in low grounds during the day or night.

Also, Manufacturers of EXPERIMENTAL METERS, GASHOLDERS, GOVERNORS, MINUTE-CLOCKS, PHOTOMETERS, &c. &c., similar to those used by Mr. King, of Liverpool.

C. and Co. continue to manufacture ordinary WET METERS of the very best description, Mr. W. Crosley having been for many years the principal and confidential assistant of his relative, the late Mr. Samuel Crosley, of Cottage Lane, City Road, up to the time of his decease, in which capacity he communicated to W. C. the secret of the mixture of the metals which has rendered the Crosley Meter so durable and superior to all others, as is evidenced by a large number of them being still at work, after having stood the test of nearly a quarter of a century's use.

By Her Majesty's Royal Letters Patent.

JAMES MEACOCK,

MANUFACTURER OF PATENT DRY AND IMPROVED WET METERS,

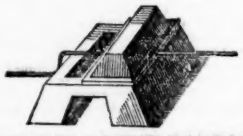
Also of every Description of Apparatus used in the Gas Factory, as well as in Gas Distribution.

7, SNOW HILL, AND GILTSPUR STREET, LONDON.

ESTABLISHED 1836.

PATRONIZED BY ALL THE GAS COMPANIES OF THE METROPOLIS, AS WELL AS MOST OF THE PROVINCIAL TOWNS.

J. MEACOCK'S PATENT DRY METER.



OLD VALVE OF THE ORDINARY DRY GAS-METER.

In the accompanying Diagrams of Meters will be seen J. MEACOCK'S patent method of securing the Leather Diaphragm of his IMPROVED PATENT DRY METER. Instead of using the soldering iron for the purpose, by which the Leather is more or less injured, it is held between two flat Metal Rings, and screwed up sound on to a frame to receive it, the outward rim of which and screw-heads are shown in the drawing.

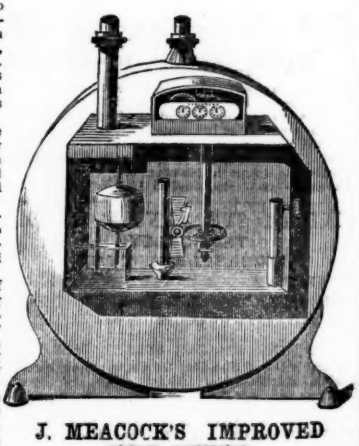
The Valve adopted in the above Patent Meter is also shown, as well as the ordinary Slide-Valve; the advantages of the former in not rising from its facing will be very apparent to the practical Gas Engineer, to whom it is of vital import.

J. MEACOCK begs leave most respectfully to submit to the notice of Gas Companies his PATENT DRY GAS-METER, trusting thereby to receive the same encouragement that has been so kindly awarded him in respect of his Improved Water-Meter, which has been patronized by all the Metropolitan Companies, as well as most of the Provincial Gas-works.

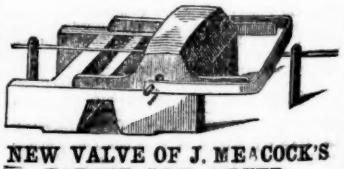
The public having been induced to desire Dry Gas-Meters in preference to Wet, and many Gas Companies being willing to yield to their wishes, J. M. has been induced to apply himself to the production of a Dry Meter, for which he has obtained Her Majesty's Royal Letters Patent.

Very frequently in fitting up the ordinary Dry Meter, the leather of the diaphragm is destroyed during the process of soldering, by coming in contact with the hot soldering iron. In his present process, J. M. has done away with its use, no solder being necessary, the leather being secured by two flat metal rings, between which it is screwed, riveted, or overlaid; the perishing effect of hot tools to leather being avoided, its durability must be longer; also, by this means, its repair when needful is most simple, as a new leather diaphragm can be applied by merely unscrewing the old one from the rim or frame to which it had previously been screwed up sound. In the ordinary Dry Meter frequent variations of registry have been detectable from defective valves, which tilt or rise from their facings: the slide-valve of this Patent Dry Meter will not allow any carbonaceous matter common to coal gas to tilt or lift the slide from its facings, and hence no variation. The heavy wear and tear to which the Meters of Gas Companies are subject, have at all times made it desirable to have them of the best materials and workmanship. J. M. begs leave to assure those who may honour him with their commands, that nothing but the stoutest materials for cases, the hardest gas-resisting metals, and best foreign leather for the interiors, will be used, and none but first-class workmen employed in their construction (the properties which his Improved Water-Meter is well known to possess, and which has obtained him that extensive patronage), will be strictly carried out in his PATENT DRY METER.

In respect of any orders with which he may be honoured, he is willing to give a guarantee to keep the same in repair, *free of all charge*, for three years, and allow the customary discount off the original list price.



J. MEACOCK'S IMPROVED WET METER.



NEW VALVE OF J. MEACOCK'S PATENT DRY METER.

WET GAS-METERS REPAIRED AND RECONSTRUCTED WITH J. MEACOCK'S MODERN IMPROVEMENTS.

METERS SENT ON APPROVAL.

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TO CORRESPONDENTS.

A. R. E.—*A general meeting of the English Company is called, and, if the press is admitted, we shall publish a report of the proceedings. The system is not likely to prove a successful competition to coal gas.*

Constant Service.—*We were unable to procure a report of the proceedings before the committee on the bill, but if you favour us with the minutes of the evidence given we will publish an abstract of them.*

NOTICES.

The subscription is 15s. per annum, if paid in advance, or 18s. on credit, payable in two sums of 9s. each, in July and January of each year, by Post-Office order, to Thomas G. Barlow, at the Charing-Cross Money-Order Office.

The next number will be published on Tuesday, Sept. 1, and the subsequent numbers on each successive alternate Tuesday.

Stamped copies, when forwarded by post, must be folded so as to expose the stamp; they are otherwise liable to the full postage charge for letters.

This JOURNAL has been duly registered at the General Post Office for transmission abroad.

All Communications to be addressed to the Editor, No. 42, Parliament Street, Westminster; and orders for Advertisements to Mr. W. B. King, the Publisher, No. 11, Bolt Court, Fleet Street.

THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 18, 1857.

NOTES UPON PASSING EVENTS.

"SAVE me from my friends," says the proverb. We wonder whether the Local Board of Works of Lambeth have thought of applying this saying to their own position, threatened as they are with a special Act of Parliament, for the purpose of compelling them to obey the quondam advocate of local self-government? No one but a modern Liberal would, indeed, have dared to say what Sir B. Hall did say, in reply to the question asked in the House of Commons, with respect to the unhealthy trades of Lambeth, as they are now fashionably called; and it is worthy of special remark, that on all occasions he has displayed a similar anxiety to enforce the enjoyment of liberty in accordance only with his own opinions. Like the Yankee, who could not believe that England was a free country, because in it "he could 'nt wallop his own nigger," Sir B. Hall cannot believe that the Lambeth authorities do their duty because they will not act as he bids them, and so, forsooth, he coolly announces that he intends next year to bring in a bill, as he says, "to compel such parties to do their duty!" In other words, some legislative enactment is to be passed to empower Sir B. Hall to destroy any trade he may consider offensive. Truly, we are becoming "continentalized" with a vengeance! and we warn the nation that, unless some vigorous resistance be at once offered to the spread of the autocratic system of administration which is now in the ascendant, it will, indeed, soon cease, as a modern French writer assures us that it has already so ceased, to be "old England"—the country, in fact, of municipal and individual liberty.

That Sir B. Hall and his partizans should feel dissatisfied with the results of their own "empirical legislation" cannot, however, be a matter of surprise. Not only are local authorities still able to exercise their own discretion as to whether or not they should proceed against a cause of nuisance, but, unfortunately, Sir B. Hall's boasted Act for the prevention of disease—a modest title, truly!—has actually destroyed, or at least crippled, the powers such local authorities formerly had of dealing with a certain class of nuisances by means of the common law. It appears that latterly the local authorities of Kensington have endeavoured to put a stop to the refining of antimony in the more densely peopled parts of their district; but, in the course of the proceedings, the advocates of the manufacturers claimed, and substantiated, their exemption from the provisions of the Act, on the score of their being specially exempted by reason of the 44th clause. Now this clause was thrust into the bill during its discussion in committee of the House of Commons by the Welsh mining interest (with which it is suspected that Sir B. Hall is himself connected), for the protection of the very important interests which had created, so to speak, such towns as Cardiff, Merthyr Tydvil, Wolverhampton, &c. But in their hurry to secure their own property, these legislators forgot to consider what might happen in other places; and, by giving a statutable protection to a certain class of operations which were formerly actionable at law, it is more than questionable whether they have not withdrawn the only protection which the public had against a class of operations which may in some cases become very serious nuisances. It may be contended that the Nuisances Removal Act does not abrogate any previous laws or statutes; but if so, what is its precise use, beyond placing in the hands—too often venal—of policemen and parish officers the power of oppressing the less noxious trades? Besides this, we suspect that the superior courts of law, finding that the Legislature expressly removed metallurgic operations from the effects of a law expressly designed to abate nuisances, are bound to consider that such operations are not of the particular description to bring them within that definition. The hasty and empirical character of the Nuisances Removal Act is, indeed, becoming every day more apparent; and recent occurrences with respect to it, and to several other Acts of a similar tendency, prove, in the most forcible manner, the necessity for a revisal of all our modern sanitary legislation.

Again and again do we repeat that the trading community of England—and, indeed, we may say of the United Kingdoms; for the Scotch, who selfishly stood aloof during the struggle against the Nuisances Removal Act of 1855, have now been made to bear their share of the burthen—would do wisely to combine with the private societies which have hitherto borne the brunt of the contest with the advocates of Administrative Centralization. We wish to be understood in this matter. Centralization is not to us the absolute bugbear which it may be to some people; for we can easily conceive that in some services—in some countries at times, in others always—the centralization of governmental action may be very desirable. But we do contend that at all times it is better to develop the independent action of local authorities, than to accustom a nation to yield itself implicitly to the guidance of the rulers of the day; that the English nation, especially, is very well able to take care of itself and of its local interests; that it is utterly false that they require, or would gain by, any application of the French doctrine (which is the key to the whole Chadwickian system), that all municipalities ought to be treated as minors and placed under the guardianship of the Central Government; we contend, in fact, that England is fitted for local self-government, and that the old laws of the land are sufficient, with very trifling modifications, to protect the rights of all. Modern legislation has been abandoned to a set of adventurers who neither know the laws of grammar, nor of logic, nor of the country they assume to rule with the hardihood which characterizes all "fools who rush in where angels fear to tread." The consequences have been that the legitimate interests of the country have been imperilled; and, had not such men as Mr. Toulmin Smith, especially, laboured earnestly—we had almost said Quixotically—to expose the follies and blunders of the law-jobbers, it is impossible to say to what extent our liberties might have been interfered with and our property destroyed. The success of Mr. T. Smith's efforts

shows what one earnest, conscientious man, thoroughly conversant with the subject he embraces, can effect; and we firmly believe that it would be to the interest of the manufacturing community to strengthen his hands, by subscribing to the Anti-Centralization Society of which he is chairman. At any rate, some measures should be taken during the recess to organize the means of representing the manufacturing interests before the select committee of the House of Commons, which must be appointed to consider the Public Health Act, 1848, in the course of next year—always supposing that the Government does not again defeat the attempt to inquire into its misdoings.

There was inserted in one of the last numbers of the *Surrey Post* an article to which we think especial attention should be called, because it contains the most bitter satire upon the unblushing effrontery of the officials who could induce Mr. Cowper to make the assertion that the result of the operations of the General Board of Health had been to reduce the rate of mortality in the towns connected with that board. In this article a list of 23 towns is given, in which the Public Health Act has been applied, and in which the mortality had actually increased. It is true that this list does not apply at the present day; and, indeed, the public has great difficulties in ever arriving at the real facts of these cases, for the official returns are always made up in such a manner as not to be susceptible of being "read by any one who runs" by like one of the profane. But certainly the statement this article contains was sufficiently startling to have merited a far more serious investigation than it received when first made before the select committee of the House of Commons in 1855; and the last quarterly returns of the Registrar-General certainly throw such a reflex light upon it, as to render it indispensable for Mr. Cowper to prove that he was not guilty of a deliberate attempt to deceive the House of Commons and the public when he made his assertion. The *Surrey Post* quotes some of the rates of mortality given by the Registrar-General for the county of Surrey; but there are other statements in these returns equally striking, though from the fact that the registration districts are not conterminous with those of the local boards of health, it is, as we said before, difficult to arrive at any correct results in an investigation of this nature. Thus the mortality in London during the quarters ending on the last day of June, in the years 1855, 1856, and 1857 respectively, were 15,001, 14,098, and 13,201: here, thank God! there is no local board of health. At Epsom, where there is a local board, the mortalities were, in the years before mentioned, 86, 83, 107—a positive increase; at Croydon, similarly inflicted, they were 179, 158, 143, but the year 1855 was close upon the sad epidemic produced by the operations of the Central Board of Health; whilst at Guildford, where there is no board, the mortalities were 162, 124, 87; at Farnham, equally fortunate, 104, 92, 87; at Dorking, 76, 48, 45; and at Kingston, 162, 131, 108. At Southampton, a place expressly cited by the Registrar-General as an illustration of the advantages to be obtained by carrying out sanitary improvements under the General Board of Health, the mortalities were 187, 214, 282! At Hitchin, also officially inflicted, they were 106, 141, 114; Coventry, 237, 223, 261; Wolverhampton, 767, 730, 1000! Halifax, 682, 778, 738; Lancaster, 182, 195, 247! whilst Liverpool, which carefully excluded the Richmond Terrace quacks, only shows mortalities, for a much larger and more constantly fluctuating population, of 2097, 1913, 2007. We do not attach much importance to these figures, for they have been obtained from observations extending over too short a period to allow of their being of any scientific value; but they are at least of as much value as Mr. Cowper's statistics, and they prove as much against the General Board of Health as the more favourable results which appear in other towns prove in its favour. With a little skill, however, anything can be proved by statistics.

In the report of the referees to whom Sir B. Hall submitted the scheme of the Metropolitan Board for the interception of the sewerage from the Thames, there is an incidental accusation against the gas companies for polluting the river by the discharge of their waste waters into it, or into the sewers. We fear that there is some truth in the accusation, and most urgently do we call upon all parties connected with this great industry to cease these infractions of the law. It is the duty of all who have made sacrifices in the attempt to comply with the requirements of the Legislature, to induce their brethren equally to perform their duty; and so awfully bad is the state of the water in the Thames at present, that it is important to check every source of corruption. One peculiarity we would, however, observe about the present state of the river is, that whilst the water is so repulsive, the bed is clearer than it used to be, in the portions between the bridges at least; and this fact would certainly appear to show that the foul smell which pervades the river, once said to be "tho' deep yet clear," is to be attributed almost exclusively to the matters which are in chemical solution, whilst the matters in suspension have but a very insignificant effect.

It appears to us, who perhaps may have a mental bias in favour of the industry we are anxious to defend, that, if the public were as much disposed to read as it is sometimes to run, the reports of the various recent railway and gas meetings would furnish matter for reflection. Railway dividends have fallen from 8 or 10 per cent. to 2½, or even 1 per cent.; whilst there are few of the London gas companies which have not continued through good seasons, and bad seasons, to pay very handsome dividends. The explanation of all this is, of course, very easy; because railways are, after all, more essentially speculations than gas-works, which are designed to supply an actual and inevitable want; whilst, moreover, the bulk of our railways have been obliged to buy their capital at such exorbitant rates from contractors, or money-lenders, that the *bond fide* shareholder stands but a poor chance of getting a fair return for his money. It would hardly be worth while here to enter into an elaborate comparison of the two classes of investment we have alluded to; but we invite the public carefully to weigh their merits. Facts are stubborn things; and it is a fact, that the returns from railway property at the present day are far less in proportion than those from gas property. What may be the comparative value of water-works it would be hard to say, because the stupidly exclusive policy of the majority of water companies prevents the public from forming any opinion upon the subject.

In a future number we propose to dwell at length upon the practical lessons to be derived from the singular accident at the Brick Lane Station of the Chartered Gaslight Company, on Friday evening last; and, also, to call attention to the discussion which took place in the House of Commons on the same evening, with respect to the Netley Hospital. The former subject is new and startling; the latter strikes us as being a singular illustration of the fatality we had before alluded to, which causes our Government to throw itself into the hands of ignorant quacks.

THE MUNICIPALITY OF MARSEILLES AND THE IMPERIAL CONTINENTAL GASLIGHT COMPANY.

The dispute between the municipality of Marseilles and the gas companies appears likely to lead to far more serious consequences than were at first suspected; and it is not impossible that the manifest incompetence of the French tribunals to administer justice may render it necessary to remove this question from the regions of law to those of diplomacy. Alas! for the company which finds itself in such a strait! But it does so happen that, unless diplomacy can aid the Marseilles companies, the mayor will establish the point for which he has contended, viz., that the municipality has unlimited power over the soil of the public ways of a town after the expiration of a contract temporarily alienating it; and thus he will be enabled to destroy, without fear of consequences, the property of all the gas companies existing in Marseilles before he concluded his bargain with M. Mirès. There are some important questions connected with this matter which might, perhaps, have an application in England as well as in France, especially since we appear to have become ambitious of imitating the continental system, and therefore we again call the attention of our readers to the subject.

Before, however, touching upon the general bearings of this case, we must observe that a careful perusal of the documents which we have been able to procure, convinces us that in the unfortunate dispute between the municipality of Marseilles and the old gas companies there were faults on both sides. The municipality seem to have begun the quarrel by imposing new burthens upon the gas makers, and by encouraging a competition against the Continental Company of an unfair and vexatious character, but a querulous spirit which was likely to increase the jealous feelings all French administrations traditionally entertain against their contractors is apparent in several of the communications of the representatives of the various gas companies which it might have been politic to avoid.

It is, indeed, one of the characteristics of all highly centralized administrations, that its agents at last come to the conviction that it is their principal duty to defend the State against the attacks of an organized band of plunderers, whose principal ambition is to rob the public in the execution of their contracts. In France this is especially the case; and so thoroughly is the tradition of the Government engineers, that all contractors are cheats, received and acted upon, that at last the bulk of public contractors have become what they were suspected of being. The Marseilles municipality seem at a very early period to have considered themselves thus in disguised war with their gas contractors; and the latter, unfortunately, seem to have resented the suspicions, and the manifest ill-will, with which they were treated, instead of endeavouring to allay or disarm those feelings. We cannot help suspecting that in 1854 it would have been possible to have put an end to a state of things so dangerous, and so unsatisfactory for both the town and the companies; but no sacrifices were made on either side, nor do the respective parties appear to have displayed any desire to conciliate one another's feelings or interests. The Mayor of Marseilles became more and more oracular and tart, the Continental Gas Company more and more obstinate in the maintenance of the strict letter of its rights; so that at last open war seems to have ensued, in which the gas company, being the weaker, has gone to the wall. The moral of all which is, that it is no use knocking your head against a stone; and that, even in 1857, might makes right.

The questions of general interest are, however, twofold; firstly, those raised by the practice of foreign, and too many English, towns of bargaining for the supply of public lights at an unremunerating price, whilst the companies are allowed to recover themselves by charging an exorbitant price for private lights. At Marseilles, M. Mirès, for instance, has undertaken to supply gas for the public lights, under very onerous conditions, at 15 ctms. per mètre cube, whilst he is entitled to charge, without any such conditions, 30 ctms. per mètre cube for the private lights. This is, in fact, neither more nor less than securing the discharge of a public service at the cost of the private consumer; and is so simple a method of catching popularity, that it has been blindly adopted by the Manchester school. Possibly there may be more justification for the adoption of this system in French towns, where the monstrously unequal and unjust system of octrois prevails, than in our own country, where municipal expenses are paid by rates; because, in the towns where octrois are levied, men only pay in proportion to their actual consumption, not in proportion to their means; so that, upon many of the most important articles, the poorer classes actually pay more than the rich, whereas in England, the contributions to municipal funds being ascertained by the value of the occupancy, the nearest possible approach is made to a proportionate distribution of the burthen. As the rich man in France does not manifestly pay his fair share of the public expenses, there may be some justification in the rude justice of making him pay a higher price for his gas, in order that the public charge may be diminished. But this consideration ceases to apply in England, and the system, adopted at Manchester, is, we believe, after all, only an indirect mode of taxing doubly the gas consumer, who may often have a bitter struggle for existence, in order to relieve the general rates of the district. Alike, however, in France or in England, the departure from the strict law of political economy, that every service should be paid for by those who benefit by it, produces confusion and injustice, from which the public must eventually suffer; for every impediment thrown in the way of the diffusion of civilization and comfort must react upon the society which commits the blunder of so acting. That an undue enhancement of the price of gas must retard its use is so self-evident that we need only allude to it, or to the necessity for the use of that light at the present day; and, as the system of making private consumers pay for the deficiencies of the public service *pro tanto* increases the price to them, that system must be considered to be at least a mistaken one.

The second question raised by these Marseilles quarrels is with regard to the power of municipalities over the soil of public ways. It had been held formerly in France that the municipalities were empowered to grant permissions for opening the streets, &c., for the purpose of laying down gas-pipes, either for the performance of a public contract, or for the supply of private lights; but it was also held, and two remarkable decisions of the Conseil d'Etat, the supreme court in all administrative suits, confirmed the opinion, that when once the permission to lay pipes in a public way had been granted, the municipality could only order those pipes to be removed when the public interest absolutely required such removal. Parties who laid down gas-pipes were, in fact, held to be entitled to enjoy their use as long as they lasted, without its being necessary to have any distinct renewal of the permission. The Mayor of Marseilles has, however, proved that this legislation is nothing more than a cobweb to entangle the weak; and he has violently pulled up the pipes of the companies he had covenanted to remove out of M. Mirès' way, leaving those companies practically without a remedy, for how is it possible to assess the damage resulting from the abrupt cessation of a service which must naturally expire of its own accord in a short time? If the central Government of France does not in some way or other punish the Mayor of Marseilles for his abuse of power, the principles will be established that municipalities may grant to their *protégés* monopolies of gas lighting, in defiance of any established rights of third parties; and that directly a contract for this purpose has expired, the municipalities are entitled to remove forcibly any pipes under their thoroughfares. The natural consequence of the establishment of these principles appears to us to be simply to compel a gas contractor to sink the cost of his works in the period of his contract, and thus either to bind the various towns for a long period, or to a high price. At any rate, it would now be folly for any gas-maker to count upon the value of the rents from private lighting after the public contract has ceased, because his means of supplying his customers may at any moment be destroyed. Eventually, the gas consumers will have to pay for this depreciation in the value of gas property.

The English legislation upon the subject of the rights of owners of gas-pipes—to retain the use of them, *in situ*, after the expiration of a contract—is equally uncertain with that of our neighbours. The Act 3 & 4 Will. IV., c. 90, does not expressly mention, in any way, the circumstances under which the permission to lay pipes is to be given; nor does it define the relative positions of the parochial authorities or of the gas contractors as to the occupation of the land. The private Acts of the London Gas Companies give a parliamentary right to open the ground for the purpose of laying the mains required, and they provide penalties against any interference with those mains; but we cannot at present discover any legal method of ascertaining the rights or powers of parochial authorities, in case of a dispute with a gas-maker, which should be carried to such an extent as to induce the former to believe themselves justified in calling for the immediate removal of the means and appliances of the latter existing in, or under, public ways. The question is, in fact, whether parochial authorities, by once granting leave to lay down pipes, confer a right of usance thereof so long as they may remain entire; for, evidently, in case of dispute, they would be entitled to refuse permission to repair, unless some statutable powers of opening the roads, &c., had been previously obtained. At present the difficulty we see is, perhaps, an imaginary one in England; but the occurrences at Marseilles, and our own progress towards centralized administration, render it desirable that parties connected with gas manufacture should examine it bytimes. The conduct of the Dover Local Board of Health towards the water companies established in that town ought to convince us, that our new municipal authorities will allow no considerations of delicacy to restrain the exercise of their powers. It becomes necessary, therefore, to define what those powers really are.

In the mean time, we recommend the committee of the Stock Exchange to examine the manner in which M. Mirès has assisted in the destruction of the property of his rivals, without much apparent benefit to himself or to his friends; for we learn that the 300 franc shares in his company have lately been quoted at 200 francs each.

ON THE REPORT OF SIR B. HALL'S REFEREES UPON THE METROPOLITAN DRAINAGE.

Perhaps the course adopted by the Metropolitan Board of Works, at the meeting of the 5th instant, was the wisest and the most consistent one it could have adopted under the peculiar circumstances of the case. After a delay of more than six months, Sir B. Hall—who, be it observed, is remarkably exacting on the score of early replies to his own communications, especially when he desires to gratify a personal pique—had forwarded to the board an insignificant portion of the report sent

to him by the three engineers whom he had consulted upon the scheme of the Metropolitan Board of Works for effecting the interception of the sewerage which now finds its way into the Thames. This report, instead of confining itself, as it ought to have done, to a mere expression of opinion upon the merits of the scheme of the Metropolitan Board, proceeded, after some preliminary remarks of a very doubtful character, in a scientific point of view, to suggest a new scheme; but, as it was not accompanied by any of the documents necessary for an understanding of the text, the Metropolitan Board were unable thoroughly to enter upon the investigation of its real merits; and they have, therefore, very properly avoided the expression of anything beyond their intention to examine any complete communication the autocratic First Commissioner of Works might make to them. In dealing with such a man as Sir B. Hall, this was the only course to be adopted; and it was, in fact, the best mode of bringing the honourable baronet's tactics to bear upon himself; for he is so punctilious, and so exacting, that it behoves all who are obliged to treat with him to require a similar exactitude on his part. Whether designedly so or not, we cannot say, but certainly Sir B. Hall's communication to the Metropolitan Board was no answer to the scheme submitted by the latter, in accordance with section 136 of the 18th and 19th Vict., c. 120; and, in fact, the referees' report, as it stands at present, ought to have no more weight with the board, or with the public, than any other scheme which might be presented for intercepting the drainage of London. Its publication strikes us as being neither more nor less than an attempt on the part of the "Marplot" of Whitehall to amuse the public, and to gain time, we suspect, with the hope that some epidemic may occur to warrant the assumption of extraordinary power on his part. Evidently, the members of the Metropolitan Board feel that somehow or other Sir B. Hall is mystifying them, and they are, therefore, on their guard against the expression of a premature opinion upon his communications. But we are in a more independent position; and as the already published portion of the report of the referees, although sadly incomplete, is yet sufficiently explicit to allow the discussion of its leading principles, we propose to examine them in some detail.

We would ask, however, before addressing ourselves to the engineering part of the report, what necessity there was for a long description of the water-shed of the lower Thames, or for a repetition of the proofs of the pollution which actually takes place in the various streams or rivers? The frightful state of the Thames, especially during the last month, when the thermometer has marked on the average about 70° in the river itself, is, unfortunately, too notorious to be denied. But this very same fact of the repulsive character of the vast body of tidal water there flowing, ought, we think, to be carefully considered by those whose duty it may be to examine the subsequent portions of the report; and implicitly it involves the most serious objection to the scheme propounded by the referees. In the report, we confess the first ten pages strike us as being little better than "surplusage," particularly as the conclusions derived from them are nothing more than the assertion of self-evident truths; such as the following passage (page 9): "We are of opinion that if the sewerage were removed from the Thames, the river would be very materially altered in character." But it is worthy of remark, that in the second foot-note of page 6, the referees mention, with an air of indirect blame, the *open* sewer lately executed by the East London Water-Works, although, as we shall have occasion to see hereafter, they themselves propose a similar work, upon a more gigantic scale. We protest, moreover, against the imitation of the system, so much abused by Mr. Chadwick and his friends, of making the statistical returns of the Registrar-General serve to prove the fashionable theory of the hour. Some years since, the mortality during the cholera years was made to prove that low levels had a pernicious effect upon health; then it proved that the water supply of the districts South of the Thames was defective; and now it seems that it proves that tide-locked sewers render those regions "valleys of the shadow of death." Nor are the referees only liable to the accusation of defective logic or of unsatisfactory attempts at philosophical reasoning; for the observations of Dr. Hoffman and Mr. Witt (as they appear at least in the extracts given page 8 of the report) are as little worthy of the scientific importance attached to them as are any of the recent publications of our so-called scientific administrations. In the particular instance to which we refer, a species of rough analysis is given of the total amounts of solid constituents of the Thames water; but we are convinced that the results are only true with respect to the particular samples examined, and that it is absurd to state that, as a rule, there is only a small difference in the impurity, that is to say, of the solid constituents, of the water at Kew Bridge and at London Bridge. Observations of this kind can only be of use on the condition of their presenting the average results of a very great number of experiments, carried on during many years, and under every variety of tidal action or of land floods. The observations of the eminent chemists reproduced in the report may then be curious and worthy of attention in conjunction with other similar documents; but they are far too superficial to justify any one in basing a train of philosophical reasoning upon them. No doubt the appendices, which we are told will shortly follow the report of the referees, will contain more complete information upon these subjects; and we shall look forward with anxiety for their appearance, not only for the sake of Dr. Hoffman's own statements, but also for the sake of Mr. Etheridge's microscopical examination of the Thames mud, which we suspect will throw some light upon the influence of the tides on the alluvions of the Thames in the portions we are most directly interested in.

We can but repeat what we said in our last number, viz.: that we see no reason for the assumption, which is one of the most important bases of the referees' scheme, that the sewerage to be dealt with must be calculated in the proportion of 7 cubic feet per head per diem of the whole population, actual and prospective. Mr. Bazalgette calculated upon 5 feet per head; and, really, when we consider that the present water supply is not equal to 40 gallons per head, and that certainly not half that quantity finds its way into the sewers, whilst the tendency of the water companies will be, or ought to be, to check the waste which now takes place in consequence of the very objectionable mode of levying water-rates without any reference to consumption, we are fairly entitled to believe that such an average (which is equal to 31·15 gallons per head per diem) is a very liberal one. In designing, however, a work intended to meet the actual and prospective requirements of a city like London, it may be safer to err by providing too much, than by an error of the opposite description; but, certainly, the referees have acted with imperial prodigality in providing for the removal of about three times the total quantity of water and sewerage which Mr. Bazalgette, decidedly, in his particular branch of the profession, the most experienced and practical engineer of the country, had considered necessary to pass through his outfall sewer. Firmly do we believe that the proportions of rainfall and sewerage Mr. Bazalgette had estimated for were sufficient; and, although his project might have been objected to on the score of its not embracing a sufficiently wide area, it must be born in mind, firstly, that he was bound to confine his scheme within the limits of the portion of the Act he was appointed to carry into effect; and, secondly, that he had to encounter great opposition from a powerful party in the Metropolitan Board, patronized by Lord Palmerston himself, on account of the colossal size of the very sewers which are now declared to be too small. Shall we hear anything more of turnip tests? The official pendulum is now oscillating, we fear, with an equally dangerous force in an opposite direction to that which was in fashion some two years since—before the reign of King Thwaites.

The portion of the referees' report upon the subject of applying the sewerage to agricultural purposes is written with such an utter disregard to the rules of grammar, or of logical arrangement, that it is beyond our power, at least, to understand exactly what it means. We gather, however, from its general tenour that those gentlemen consider deodorization to be useless, and that it would be impossible to apply the sewerage by irrigation. This may be true, and, indeed, we suspect that it is so in the present state of science; but we confess that we have more confidence in the practical skill of our chemists and of our manufacturers than thus to despair of the solution of one of the greatest problems of the age. If it be true that the annual value of the fertilizing matters now wasted is £1,000,000, the sacrifice is so enormous that it would justify, almost, an outlay of £20,000,000 to put an effectual stop to it. Why is nothing done to secure this result? Why is not a really scientific commission appointed by the Metropolitan Board to inquire into the subject? An outlay of £10,000 would be wisely incurred in such a cause; but it

must be observed that far greater judgment is required in the selection of the members of such a commission than the Government itself lately has displayed. With the exceptions of Mr. Lawes and of Mr. Way, there is no one upon the Government Commission for the Application of Town Sewerage whose opinion would be listened to by competent persons; yet how immeasurable is the importance of the investigation. If, therefore, the result of this part of the referees' report should be to direct public attention to the subject, whatever may be its defects, it will at least indirectly effect a great public service.

No doubt the authors of the various rejected schemes for the removal of the London sewerage from the Thames will bitterly criticize the parts of the referees' report in which their merits are discussed; and we are hardly disposed at present to mix ourselves up in the controversy which will infallibly arise. The only remark we have at present to make upon this part of the subject is, therefore, that we again protest against the very unphilosophical character of the float-tests or of the recorded observations upon the tides and upon the other conditions of the flow of water in the Thames. In a document of such importance as the report of the advisers of the Crown upon a question likely to affect the health of one of the densest agglomerations of population, and certainly to affect the navigation of a river which bears the most active and the richest traffic in the world, the public is entitled to call for a thorough examination of all the conditions of its tides, of the alluvions, of the land waters, and of the actions and reactions of both land and streams. There is, however, little beyond an occasional reference to some chance experiments, or to some notoriously incomplete observations of men of very doubtful merit. Indeed, the whole question of the state of the river Thames, both in a sanatory and in a commercial point of view, is in so unsatisfactory a position that we must beg to call the serious attention of the public authorities to it. Many of the inconveniences now attributed to the discharge of the sewerage into the river, the accumulation of black mud, and the formation of shoals, might be materially obviated by a more systematic enforcement of the plans already proposed for the embankment of the portions within the limits of the conservancy of the river entrusted to the corporation. There is, amongst the public in general, a sad amount of ignorance with respect to the natural laws affecting large rivers; and we would only refer to Mr. Doulton's letter in the *Times*, of the 10th instant, as a proof of this fact. No safe conclusions can be arrived at, however, until the various phenomena of the Thames have been carefully studied; and studied, be it observed, in a far more philosophical spirit than they have hitherto been—unless, indeed, an exception be made in favour of Sir J. Lubbock and Dr. Whewell's observations upon the tides. The portion of the referees' report in which they discuss the best position for the outfall, seems to us to be nearly as unsatisfactory as Mr. Doulton's letter, and to display in a very forcible manner the necessity for some further truly scientific investigation of the question.

We propose to continue the examination of this very important subject in a subsequent number, inasmuch as our limits preclude us from treating it, at present, to the extent which it really merits.

Circular to Gas Companies.

At a most opportune moment, when gas managers are required to purify their gas, with a minimum of expense, of nuisance, and of deterioration, Mr. Laming announced in glowing terms, by an advertisement which recently appeared in our columns, that grand desideratum—an absolutely unobjectionable process, offering "economy in room, labour, and materials; impossibility of nuisance; and a total absence of injury to the illuminating power." Curiosity was universally excited by this announcement, which it has been impossible to gratify till the all-important document termed the "specification" was registered; and we will now endeavour, as far as the obscurity, complexity, and verbosity of this specification will admit, to extract from it the "two grains of wheat hid in two bushels of chaff."

We have no fewer than six distinct claims for six separate presumed discoveries. Let us examine them *seriatim*.

1. In the manufacture of phosphorus, bone ash is usually treated with sulphuric acid, and the resulting sulphate of lime is most carefully separated from the solution of phosphoric acid, which is mixed with charcoal, dried, and distilled. Mr. Laming proposes to saturate the phosphoric acid with ammonia, and to dispense with the separation of the sulphate of lime. It unfortunately happens, however, that the non-removal of the sulphate of lime will, according to the experience of all phosphorus makers, inevitably necessitate the non-production of phosphorus; but, on the other hand, the addition of ammonia would seem to be a perfectly harmless, though, we fear, a somewhat costly amusement. It seems clear to us, that superphosphate of lime, or the product of the action of sulphuric acid upon bones, if used to abstract ammonia from foul gas, must find its way, eventually, not into lucifer matches, but into the soil.

2. We believe that in some few gas-works Phillips' process of washing gas with a solution of green vitriol has been used, whereby, as all the world knows, sulphate of ammonia and sulphuret of iron are produced. Mr. Laming, with a most praiseworthy stretch of ingenuity, proposes that these two substances should be separated from one another by subsidence and filtration; that the solution of sulphate of ammonia should be evaporated down to crystallize; and that the moist sulphuret of iron should be mixed with anything, and be *revivified* or oxidized in the usual manner, by exposure to the air!!! Were the novelty of this process only equal to its simplicity, it would command our most unqualified approval.

3. In the articles on the "Chemistry of Gas Lighting," which appeared some time since in this Journal, it was observed that "the difficulty of gas-purification arose, not from the presence, but from the absence of ammonia." In accordance with this principle, attempts have been made to introduce free ammonia into gas, with a view to facilitate the removal of the carbonic and hydrosulphuric acids. These attempts, however, have been discarded on the score of expense. Mr. Laming, therefore, reverts to an indirect use of free ammonia, but at the same time contrives to prepare his ammonia more expensively than did any of his predecessors. Ammonia is usually made by distilling muriate of ammonia with lime. Mr. Laming makes his ammonia by distilling muriate of ammonia with chalk, redistilling the resultant carbonate of ammonia with sulphuret of sodium, and reacting on the resultant hydrosulphate of ammonia with revivifiable oxide of iron. His process of purification is as follows:—The foul gas from the condenser is either to be charged with hydrosulphate of ammonia by passing through a saturated solution of that salt, or is to be directly mixed with the vapour of hydrosulphate of ammonia, as issuing from the retort in which it is produced from the distillation of carbonate of ammonia with sulphuret of sodium. The gas and hydrosulphate of ammonia are to pass into a dry-lime purifier, charged in the usual manner with oxide of iron. The oxide will decompose the introduced hydrosulphate of ammonia as well as that naturally existing in the gas, will retain the hydrosulphuric acid, and set free the ammonia, which will then unite with the carbonic acid of the gas to form carbonate of ammonia, a substance readily capable of being removed by a "scrubber." For the successful working of this process, it will be necessary to supply a quantity of ammonia sufficient to saturate the whole of the carbonic acid existing in the gas; and, to effect this object, we shall have to introduce at least three times as much hydrosulphuric acid as the gas originally contained; whereby it is evident that, with the same amount of oxide, the revivification will have to take place four times as frequently as at present, and the material be spent or exhausted in one-fourth the usual time. As regards the sanitary bearings of the question, every one knows that hydrosulphate of ammonia stinks horribly; and any one will find that in manufacturing and using it as Mr. Laming suggests, it will be impossible to avoid a most objectionable escape of vapour.

4. We now come to a part of the specification so confusedly described that we confess our inability to ascertain its exact meaning. Mr. Laming, we conceive, proposes to pass the vapour of hydrosulphate of ammonia into a covered tank, containing layers of oxide-of-iron-mixture, spread upon sacking, and drenched with water. The liquid is to be drawn off by a stop-cock, and again passed over the oxide, whereby it will become converted into a solution of free ammonia; or a solution of free ammonia is to be made from ordinary gas liquor, by first passing it over the iron mixture, to remove the hydrosulphuric acid, and then treating it with caustic lime to precipitate the carbonic acid. The solution of free ammonia, obtained by one or other of these methods, is to be used for washing the gas in a scrubber arranged for the purpose. Mr. Laming recommends that the revivification

of the oxide that has been employed for the production of free ammonia, should be effected by passing a current of air through it while still wet, whereby any inconvenient elevation of temperature will be avoided. He also patents the same plan applied to the revivification of oxide that has been used in the ordinary way; that is to say, he claims as a novelty the drenching of the oxide with water, and the passing of a current of air over the wet material still contained in the purifier!

5. This section is devoted to a very tedious description of a wet scrubber, which appears to be but a very slight modification of the one introduced by Mr. Laming rather more than a twelvemonth ago. We imagine Mr. Laming's ultimate intention to be, that the gas from the condenser should first be scrubbed with dry coke, then scrubbed in his patent scrubber with free ammonia prepared by his patent process, and should finally be washed with water; at least, so we judge from the advertisement, which states that, "instead of the purifying-house, two vessels of small area, placed after the condenser, suffice; that these vessels never have the least communication with the atmosphere; and that neither lime, oxide, or any other substance foreign to the gas itself, is brought into contact with it."

6. Lastly, Mr. Laming lays claim to the treatment, with a solution of green vitriol, of the distillate from gas liquor or ammoniacal washings, the results of which operation are to be separated by subsidence and filtration. The iron precipitate is to be revivified and used for purification; the filtrate containing sulphate of ammonia to be evaporated and crystallized.

We have endeavoured to exhibit fairly to our readers the nature of Mr. Laming's specification, and must leave them to estimate the merits of the separate items.

We borrow from the *Gas and Water Times* the following abstract of the preliminary proceedings in the reference of the Great Central Consumers' Company and Mr. Croll, and congratulate the parties on the good sense they have shown in disposing of one of the most knotty questions in so amicable a spirit. Our contemporary says:—"The arbitrators met at Mr. Hoggins' chambers on the 4th inst., when some preliminary discussion took place, and the next sitting was arranged for the 20th of October, the sittings to be continued day by day until the arbitration is concluded. The Great Central was represented on the occasion by Mr. Horatio Lloyd (counsel) and Mr. Davidson (solicitor). Mr. Croll was represented by Mr. Archibald (counsel) and Mr. G. Bower (solicitor). The directors opened their case by putting in the various written documents upon which they seek to establish their contract with Mr. Croll, and proceed to give evidence upon the condition of the works. At the suggestion of that gentleman, however, it was agreed that one of the engineers who had examined the works on the part of the company, and another who had made the late investigation on the part of Mr. Croll, should at once compare notes, and endeavour to agree upon a sum to represent the cost of replacing the works in a fit and proper condition for the manufacture of gas, as well as what further sum would represent the entire depreciation, or, in other words, would convert the works into a condition equal to new. This suggestion being agreed to, Mr. (Alex.) Wright was selected by the company, and Mr. Laing by Mr. Croll. These gentlemen retired to consider the propositions submitted to them, and in half an hour reported that, in their opinion, £4000 is sufficient to cover the first contingency, and that an additional sum of £6000 would amply meet the second. This opinion was given in evidence, and necessarily economized a great deal of time to both sides, dispensing as it did with a large amount of professional evidence in detail. The arbitrators, it should be mentioned, have yet to determine whether Mr. Croll ought to be called upon to pay the whole or any portion of these amounts. Mr. Croll, we understand, is of opinion that his arrangements with the company do not render him liable to any such outlay. It is understood that Mr. Lloyd at the next meeting will finish that part of his case having reference to the condition of the works, immediately after which the case of Mr. Croll will be opened, when his claims for professional services, for higher illuminating power, and for the use of gas other than that stipulated for, will receive the attention of the arbitrators." We have only to add, that the several sums of £4000 and £6000 are exclusive of the depreciation in the value of the mains, services, and meters.

We have reason to believe that the imperfect custom-house arrangements at Newcastle-upon-Tyne and Shields permit the substitution of an inferior for a superior coal, and that this fraud is continually taking place. It appears to be unnecessary, in order to clear out a vessel at either of the above-named ports, for exporters to have any certificate from the authorized office of a colliery by which the *bond fide* origin of the cargo may be properly verified; and we are informed that by this means considerable quantities of very inferior coal are shipped under good names. The consumer of the article is thereby defrauded and deceived, and the reputation of the coal of which the name is assumed is seriously damaged.

We recommend all foreign consumers to insist upon having a proper certificate from the Colliery Office, and also, as a further check, when they buy through an intermediate agent, to obtain, in the first instance, a form of certificate signed by the "*colliery fitter*," to verify the subsequent documents. The system of nomenclature adopted in the north-country coal trade is involved in such inextricable mystification and obscurity, for the purpose of blinding purchasers by means of a continued play upon the name of a genuine high-class coal, that the consumer is frequently made to believe he has obtained a coal of generally-acknowledged superior quality for his particular purpose, when he is, in fact, purchasing a spurious article bearing a name borrowed from some favourite, and often *distant*, locality, and adopted with the view of giving it a fictitious value. The nomenclature being thus mystified, the principles which apparently actuate the purchasers of coals are sometimes equally incomprehensible, and we feel at a loss to understand how they make it suit their purpose to buy a description of coal of acknowledged inferior quality when they have further to incur heavy additional charges in the shape of freight, and, in some cases, of inland transport. It is well worth paying 6d. per ton extra on the price to ensure the shipment of superior coal; but to effect such a paltry saving in the first cost, coals of a most inferior quality are very frequently shipped and sent to places where every *hundred* cubic feet diminished yield of gas is a direct loss of more money than the apparent saving in price.

Communicated Articles.

ON THE SOUNDS PRODUCED BY THE COMBUSTION OF GASES IN TUBES*.

By JOHN TYNDALL, ESQ., F.R.S.

In the first volume of "Nicholson's Journal," published in 1802, the sounds produced by the combustion of hydrogen in tubes are referred to as having been "made in Italy:" Dr. Higgins, in the same place, shows that he had discovered them in the year 1777, while observing the water formed in a glass vessel by the slow combustion of a slender stream of hydrogen. Chladni, in his "Akustik," published in 1802, page 74, speaks of their being mentioned, and incorrectly explained, by De Luc in his "New Ideas on Meteorology:" I do not know the date of the volume. Chladni himself showed that the tones produced were the same as those of an open pipe of the same length as the tube which encompassed the flame. He also succeeded in obtaining a tone and its octave from the same tube, and in one case obtained the fifth of the octave. In a paper published in the *Journal de Physique* in 1802, G. De la Rive endeavoured to account for the sounds by referring them to the alternate contraction and expansion of aqueous vapour; basing his opinion upon a series of experiments of great beauty and ingenuity made with the bulbs of thermometers. In 1818 Mr. Faraday took up the subject, and showed that the tones were produced when the glass tube was enveloped by an atmosphere higher in temperature than 212° Fahr. That they were not due to aqueous vapour, was further shown by the fact that they could be produced by the combustion of carbonic oxide. He referred the sounds to successive explosions produced by the periodic combination of the atmospheric oxygen with the issuing jet of hydrogen gas. This is undoubtedly the true source of the sounds.

I am not aware that the dependence of the pitch of the note on the size of the flame has as yet been noticed. To this point I will, in the first place, briefly direct attention.

A tube 25 inches long was placed over an ignited jet of hydrogen: the sound produced was the fundamental note of the tube.

A tube 12½ inches long was brought over the same flame, but no sound was obtained.

The flame was lowered, so as to make it as small as possible, and the tube last mentioned was again brought over it; it gave a clear melodious note, which was the octave of that obtained with the 25-inch tube.

The 25-inch tube was now brought over the same flame; it no longer gave its fundamental note, but exactly the same note as that obtained from the tube of half its length.

Thus we see, that although the speed with which the explosions succeed each other depends upon the length of the tube, the flame

* From the *Philosophical Magazine*.

has also a voice in the matter: that to produce a musical sound, its size must be such as to enable it to explode in unison either with the fundamental pulses of the tube, or with the pulses of its harmonic divisions.

With a tube 6 feet 9 inches long, by varying the size of the flame, and adjusting the depth to which it reached within the tube, I have obtained a series of notes in the ratio of the numbers 1, 2, 3, 4, 5.

These experiments explain the capricious nature of the sounds sometimes obtained by lecturers upon this subject. It is, however, always possible to render the sounds clear and sweet, by suitably adjusting the size of the flame to the length of the tube*.

Since the experiments of Mr. Faraday, nothing, that I am aware of, has been added to this subject, until quite recently. In a recent number of Poggendorff's "Annalen," an interesting experiment is described by M. Schaffgotsch, and made the subject of some remarks by Prof. Poggendorff himself. A musical note was obtained with a jet of ordinary coal-gas, and it was found that when the voice was pitched to the same note, the flame assumed a lively motion, which could be augmented until the flame was actually extinguished. M. Schaffgotsch does not describe the conditions necessary to the success of his experiment; and it was while endeavouring to find out these conditions that I alighted upon the facts which form the principal subject of this brief notice. I may remark that M. Schaffgotsch's result may be produced, with certainty, if the gas be caused to issue under sufficient pressure through a very small orifice.

In the first experiments I made use of a tapering brass jet, 10½ inches long, and having a superior orifice about 1-20th of an inch in diameter. The shaking of the singing flame, within the glass tube, when the voice was properly pitched, was so manifest as to be seen by several hundred people at once.

I placed a syrene within a few feet of the singing flame, and gradually heightened the note produced by the instrument. As the sounds of the flame and syrene approached perfect unison, the flame shook, jumping up and down within the tube. The interval between the jumps became greater, until the unison was perfect, when the motion ceased for an instant; the syrene still increasing in pitch, the motion of the flame again appeared, the jumpings became quicker and quicker, until finally it escaped cognizance by the eye.

This experiment showed that the jumping of the flame, observed by M. Schaffgotsch, is the optical expression of the *beats* which occur at each side of the perfect unison: the beats could be heard in exact accordance with the shortening and lengthening of the flame. Beyond the region of these beats, in both directions, the sound of the syrene produced no visible motion of the flame. What is true of the syrene is true of the voice.

While repeating and varying these experiments, I once had a silent flame within a tube, and on pitching my voice to the note of the tube, the flame, to my great surprise, instantly started into song. Placing the finger on the end of the tube, and silencing the melody, on repeating the experiment the same result was obtained.

I placed the syrene near the flame, as before. The latter was burning tranquilly within its tube. Ascending gradually from the lowest notes of the instrument, at the moment when the sound of the syrene reached the pitch of the tube which surrounded the gas flame, the latter suddenly stretched itself and commenced its song, which continued indefinitely after the syrene had ceased to sound.

With the jet which I have described, and a glass tube, 12 inches long, and from ½ to ¾ of an inch internal diameter, this result can be obtained with ease and certainty. If the voice be thrown a little higher or lower than the note due to the tube, no visible effect is produced upon the flame: the pitch of the voice must lie within the region of the audible beats.

By varying the length of the tube we vary the note produced, and the voice must be modified accordingly.

That the shaking of the flame, to which I have already referred, proceeds in exact accordance with the beats, is beautifully shown by a tuning-fork which gives the same note as the flame. Loading the fork so as to throw it slightly out of unison with the flame, when the former is sounded and brought near the flame, the jumpings are seen at exactly the same intervals as those in which the beats are heard. When the tuning-fork is brought over a resonant jar or bottle, the beats may be heard and the jumpings seen by a thousand people at once. By changing the load upon the tuning-fork, or by slightly altering the size of the flame, the quickness with which the beats succeed each other may be changed, but in all cases the jumpings address the eye at the same moment that the beats address the ear.

With the tuning-fork I have obtained the same results as with the voice and syrene. Holding a fork over a tube which responds to it, and which contains within it a silent flame of gas, the latter immediately starts into song. I have obtained this result with a series of tubes varying from 10½ to 29 inches in length. The following experiment could be made. A series of tubes, capable of producing the notes of the gamut, might be placed over suitable jets of gas; all being silent, let the gamut be run over by a musician with an instrument sufficiently powerful, placed at a distance of twenty or thirty yards. At the sound of each particular note, the gas-jet contained in the corresponding tube would instantly start into song.

I must remark, however, that with the jet which I have used, the experiment is most easily made with a tube about 11 or 12 inches long; with longer tubes it is more difficult to prevent the flame from singing spontaneously, that is, without external excitation.

The principal point to be attended to is this. With a tube, say of 12 inches in length, the flame requires to occupy a certain position in the tube in order that it shall sing with a maximum intensity. Let the tube be raised, so that the flame may penetrate it to a less extent; the energy of the sound will be thereby diminished, and a point (A) will at length be attained where it will cease altogether. Above this point, for a certain distance, the flame may be caused to burn tranquilly and silently for any length of time, but when excited by the voice it will sing.

When the flame is too near the point (A), on being excited by the voice or by a tuning-fork, it will respond for a short time and then cease. A little above the point where this cessation occurs, the flame burns tranquilly, if unexcited, but if once caused to sing it will continue to sing. With such a flame, which is not too sensitive to external impressions, I have been able *to reverse the effect hitherto described*, and to stop the song at pleasure by the sound of my voice, or by a tuning-fork, without quenching the flame itself. Such a flame I find may be made to obey the word of command, and to sing or cease to sing as the experimenter pleases.

The mere clapping of the hands, producing an explosion, shouting at an incorrect pitch, shaking of the tube surrounding the flame, are, when the arrangements are properly made, ineffectual. Each of these modes of disturbance doubtless affects the flame, but the impulses do not accumulate, as in the case where the note of the tube itself is struck. It appears as if the flame were *deaf* to a single impulse, as the tympanum would probably be, and, like the latter, needs the accumulation of impulses to give it sufficient motion. A difference of half a tone between two tuning-forks is sufficient to cause one of these to set the flame singing, while the other is powerless to produce this effect.

I have said that the voice must be pitched to the note of the tube which surrounds the flame; it would be more correct to say the note produced by the flame when singing. In all cases, this note is sensibly higher than that due to the open tube which surrounds the flame: this ought to be the case, because of the high temperature of the vibrating column. An open tube, for example, which, when a tuning-fork is held over its end, gives a maximum reinforcement, produces, when surrounding a singing flame, a note higher than that of the fork. To obtain the latter note, the tube must be sensibly longer.

What is the constitution of the flame of gas while it produces musical sounds? This is the next question to which I will briefly call attention. Looked at with the naked eye, the sounding flame appears constant; but is the constancy real? Supposing each pulse to be accompanied by a physical change of the flame, such a change would not be perceptible to the naked eye, on account of the velocity with which the pulses succeed each other. The light of the flame would appear continuous on the same principle that the troubled portion of a descending liquid jet appears continuous, although by proper means this portion of a jet can be shown to be composed of isolated drops. If we cause the image of the flame to pass speedily over different portions of the retina, the changes accompanying the periodic impulses will manifest themselves in the character of the image thus traced.

I took a glass tube 3 feet 2 inches long, and about an inch and a half in internal diameter, and, placing it over a very small flame of olefiant gas (common gas will also answer), obtained the fundamental note of the tube. On moving the head to and fro, the image of the sounding flame was separated into a series of distinct images: the distance between the images depended upon the velocity with which the head was moved. This experiment is suited to a darkened lecture-room. It was still easier to obtain the separation of the images in this way, when a tube 6 feet 9 inches in length and a larger flame were made use of.

As suggested to me by a lady to whom I had the pleasure of showing these experiments, the same result is obtained when an opera-glass is moved to and fro before the eye.

But the most convenient mode of observing the flame is with a mirror; and it can be seen either directly in the mirror, or by projection upon a screen.

A lens of 33 centimeters focus was placed in front of a flame of common gas upwards of an inch long, and a paper screen was hung at about 6 or 8 feet distance behind the flame. In front of the lens a small looking-glass was held, which received the light that had passed through the lens, and reflected it back upon the screen placed behind the latter. By adjusting the position of the lens, a well-defined inverted image of the flame was obtained upon the screen. On moving the mirror the image was displaced; and, owing to the retention of the impression by the retina, when the movement was sufficiently speedy, the image described a continuous luminous track. Holding the mirror still, the 6-foot 9-inch

* With a tube 14½ inches in length and an exceedingly minute jet of gas, I obtained, without altering the quantity of gas, a note and its octave: the flame possessed the power of changing its own dimensions to suit both notes.

tube was placed over the flame: the latter changed its shape the moment it commenced to sound, remaining, however, well defined upon the screen. On now moving the mirror, a totally different effect was produced: instead of a continuous track of light, a series of distinct images of the sounding flame was observed. The distance of these images apart varied with the motion of the mirror; and, of course, could be made, by suitably turning the reflector, to form a ring of images. The experiment is beautiful, and in a dark room may be made visible to a large audience.

The experiment was also varied in the following manner:—A triangular prism of wood had its sides coated with rectangular pieces of looking-glass; it was suspended by a thread, with its axis vertical; torsion was imparted to the thread, and the prism acted upon by this torsion caused to rotate. It was so placed that its three faces received in succession the beam of light sent from the flame through the lens in front of it, and threw the images upon the screen. On commencing its motion, the images were but slightly separated, but became more and more so as the motion approached its maximum. This once past, the images drew closer together again, until they ended in a kind of luminous ripple. Allowing the acquired torsion to act, the same series of effects could be produced, the motion being in an opposite direction. In these experiments, that half of the tube which was turned towards the screen was coated with lampblack, so as to cut off the direct light of the jet from the screen *.

But what is the state of the flame in the interval between two images? The flame of common gas or of olefiant gas, owes its luminousness to the solid particles of carbon discharged into it. If we blow against a luminous gas-flame, a sound is heard, a small explosion in fact, and by such a puff the luminousness may be caused to disappear. During a windy night the exposed gas-jets in the shops are often deprived of their light and burn blue. In like manner the common blowpipe-jet deprives burning coal-gas of its brilliant light. I hence concluded, that the explosions, the repetition of which produces the musical sound in the case before us, rendered, at the moment they occurred, the combustion so perfect as to extinguish the solid carbon particles; but I imagined that the images on the screen would, on closer examination, be found united by spaces of blue, which, owing to their dimness, were not seen by the method of projection. This in many instances was found to be the case.

I was not, however, prepared for the following result:—A flame of olefiant gas, rendered almost as small as it could be, was procured. The 3-foot 2-inch tube was placed over it; the flame on singing became elongated and lost some of its light, still it was bright at the top; looked at in the moving mirror, a beaded line of great beauty was observed: in front of each bead was a little luminous star; after it, and continuous with it, a spot of rich blue light, which terminated and left, as far I could judge, a perfectly dark space between it and the next following luminous star. I shall examine this further when time permits me; but, as far as I can at present judge, the flame was actually extinguished and relighted in accordance with the sonorous pulsations.

When a silent flame, capable, however, of being excited by the voice in the manner already described, is placed within a tube, and the continuous line of light produced by it in the moving mirror is observed, I know no experiment more pretty than the resolution of this line into a string of richly luminous pearls at the instant when the voice is pitched to the proper note. This may be done at a considerable distance from the jet, and with the back turned towards it.

The change produced in the line of beads when a tuning-fork capable of giving beats with the flame is brought over the tube, or over a resonant jar near it, is also extremely interesting to observe. I will not at present enter into a more minute description of these results. Sufficient, I trust, has been said to induce experimenters to produce the effects for themselves; the sight of them will give more pleasure than any description of mine could possibly do.

* Since these experiments were made, Mr. Wheatstone has drawn my attention to the following passage, which proves that he was the first to make use of the rotating mirror in examining a singing flame:—"A flame of hydrogen gas burning in the open air presents a continuous circle in the mirror; but, while producing a sound within a glass tube, regular intermissions of intensity are observed, which present a chain-like appearance, and indicate alternate contractions and dilatations of the flame corresponding with the sonorous vibrations of the column of air."—*Phil. Trans.*, 1834, p. 586.

Register of New Patents.

311.—Richard Laming, of Hayward's Heath, Cuckfield, in the co. of Sussex, for "*Improvements in purifying gas, in obtaining materials useful for that purpose, and in working up into useful products certain ammoniacal and phosphatic substances obtainable as residues in the purifying of gas.*" Patent dated Feb. 3, 1857.

When bone or other form of phosphate of lime is first acted upon by sulphuric acid, and then its phosphoric acid combined with ammonia, either during the purification of gas or by other chemical means, phosphate of ammonia is one of the results. Part of this invention consists in applying that phosphate of ammonia, without separation from the earthy material in which it is formed, to the manufacture of phosphorus, for which purpose it is ground with about half its weight of charcoal or other tenacious form of carbon, and the mixture having been dried, it is submitted in earthen retorts to a temperature gradually raised to bright redness. At first, some ammonia, unless wholly driven off during the drying, accompanied by other gases, comes from the retorts, and may be fixed by a bath of sulphuric acid or other known means. Before the phosphorus begins to come over, the ends of the eduction-pipes are sealed by water, and the distillation and subsequent stages of manufacture are conducted in the ordinary manner.

When gas is purified from ammonia by washing it with a solution of sulphate of iron, the following means are combined for obtaining from the residue of the process both sulphate of ammonia and a material containing hydrated peroxide of iron. When the sulphate of iron in the solution has been completely decomposed by the impurities of the gas, the residue is allowed to flow into a tank to settle, and so much of the supernatant clear solution as is obtainable, after as many hours rest as can conveniently be allowed, having been drawn off, the thicker portion which remains is well mixed with two or three times its bulk of water, and immediately run into a large shallow sand filter, the sand being covered with coarse sacking, and lying on similar sacking, supported by a layer of pebbles.

The liquor which runs from the filter, as well as that drawn from the precipitating vessel, is evaporated in any convenient manner in order to obtain the sulphate of ammonia which they contain, and a precipitate will be left upon the filter, which is for the most part sulphuret of iron. This precipitate is incorporated with as much ground unslacked lime, or magnesia, or both, as will serve to absorb the remaining water, and thus make it more pervious to the atmosphere, care being taken not to let the mixture become either lumpy or very hot. Sometimes, instead of the substances above-named, the precipitate is first well mixed with about three times its bulk of dry sawdust, and then about half its volume of dry slacked lime, or magnesia, or both, or of dry powdered carbonate of lime, carbonate of magnesia, or both; and when the mass has thus been made more pervious to air, it is left to oxidize.

When gas is purified in dry-lime purifiers by materials containing hydrated peroxide of iron, destined to be changed many times into sulphuret of iron by abstracting its sulphuretted hydrogen, and to undergo alternate peroxidation or revivification by mere exposure to the air (as first practised by the patentee, and made known by his French *brevet*, specified in February, 1849), it has been usual to remove from the gas its hydrosulphate of ammonia, either as a preliminary measure or simultaneously with the use of the oxide. By the present invention, the opposite plan is adopted of introducing into gas about to be purified from sulphuretted hydrogen by iron, in any state which enables it to abstract that impurity and to undergo revivification alternately, an additional quantity of hydrosulphate of ammonia. One of the principal impurities to be removed from gas is carbonic acid, and it is well known that all peroxides of iron are perfectly incompetent to remove it. It is also true that if the carbonic acid in gas could be combined with even less than a full equivalent of ammonia, it would be thereby entirely changed from a very insoluble gas into a free soluble salt, and thus be easily removeable by a small quantity of water.

By mixing hydrosulphate of ammonia with the impure gas, and introducing both together into the iron material, the ammoniacal salt becomes decomposed, its sulphuretted hydrogen is fixed, and its ammonia is set free to combine with and render soluble the carbonic acid.

Hydrosulphate of ammonia for this purpose may be obtained from any known source, as, for example, by exposing to a heat gradually raised to redness, in retorts communicating with the induction-pipe of the purifiers a mixture of carbonate of ammonia and sulphuret of sodium, in about equivalent proportions; or the gas on its way to the oxide purifiers may be washed with a solution so strong of hydrosulphate of ammonia as to surrender it to the passing gas instead of absorbing it out from the gas, as is the case when ordinary gas liquor, which is comparatively weak in hydrosulphate, is used in washers or scrubbers for the purpose of being strengthened.

The quantity of hydrosulphate needed will, of course, vary with the kinds of coal or material from which the gas is made; but the rule is to make it so large that the gas, on leaving the purifiers, shall contain no carbonic acid that cannot be washed out of it, as a soluble salt, by a little water; and, if an excess be introduced, it will cause no inconvenience.

The last traces of ammonia or ammoniacal salt may be washed out from the gas in any known manner, but the patentee prefers, in all cases, to use for that purpose the diaphragm scrubber for which he obtained letters patent, dated 20th February, 1856, or rather that improvement on it which is subsequently described in this specification, by means of which ammonia may be economized.

Instead of water washing, other known means for removing the combined ammonia and carbonic acid may be substituted with more or less effect, as, for example, washing the gas with solutions of sulphate of iron; but the patentee prefers to use plain water. This addition to the revivified oxide of iron process of purification is equally applicable whether the oxide material be used catalytically, as described in the specification of his patent dated 12th August, 1852, by introducing into the gas, before its purification, a quantity of oxygen gas (either pure or mixed as in atmospheric air, if its nitrogen be not objected to for the injury it does to the illuminating power) equal to the volume of the sulphuretted hydrogen to be removed from it, or in the strictly chemical manner which he introduced originally.

The power which revivifiable peroxide of iron has of absorbing rich hydrocarbons, has been urged against its adoption for the purification of gas; and has suggested a modification of the foregoing process, by which the ammonia is obtained in a free state, without requiring the gas to be brought into contact with the oxide. It consists in acting on solutions of hydrosulphate of ammonia by hydrated or revivified peroxide of iron, or any suitable preparation or mixture thereof, uncombined with an acid, sufficient for fixing the bulk of the ammonia.

The use of free ammonia for purifying gas, by rendering its sulphuretted hydrogen and carbonic acid removeable by solution in a little water, is not new, having been made public by the specification of a patent lately abandoned; and therefore it is not claimed as part of this invention.

By the present process, the oxide becomes changed into sulphuret of iron, which by exposure, as prescribed in the specification of patent bear-

ing date the 4th of November, 1847, is changed by the air into an effective peroxide.

The following are some of the ways in which this part of the invention is brought into operation. The vapour of hydrosulphate of ammonia, obtained from any convenient source, is received into the upper part of the covered tank, almost wholly occupied with any revivifiable peroxide of iron, made porous by a suitable admixture of sawdust or other material, spread upon sieves covered with coarse sacking, to prevent its being washed through them. Over the surface of the oxide material is distributed, by any means used for spreading liquids in gas purifiers, as much water as will carry down the hydrosulphate of ammonia into the porous material, which, by absorbing the sulphuretted hydrogen, changes the solution into one of free or caustic ammonia. This is then drawn off by means of a cock placed near the bottom of the vessel; or otherwise the vapour of the hydrosulphate of ammonia is condensed, so as to obtain it dissolved in water. The solution is then either distributed all over the surface of the material, as above stated; or, after shutting the cock at the bottom of the vessel, it is filled up with the ammoniacal solution, which, having stood on the material for a few minutes, is run off again by opening the cock.

Another way of practising this part of the invention is to agitate a solution of hydrosulphate of ammonia with hydrated or revivified peroxide of iron, or any preparation or mixture of iron capable of abstracting from the solution its sulphuretted hydrogen, without fixing the bulk of its ammonia, and then to leave the mixture at rest until the solution of free ammonia can be run off, and the solid precipitate be exposed to the air to oxidize. Whatever be the means used to bring the solution of hydrosulphate of ammonia and the metallic reagent into chemical action, if the latter be rich in effective iron, and the former only ordinarily strong, as much of the solution may be thus treated as will fill the tank over and over again, before the energy of the metallic reagent will be exhausted. The patentee prefers to oxidize the sulphuret of iron produced in this way by forcing atmospheric air through vessels containing the drained but still wet porous material, blowing the gaseous products of the operation into diluted sulphuric acid to arrest ammonia; and either conducting the residue, which is not so fixed, into the hot flues of the works, or allowing it to mix freely with the air, as it is quite or nearly devoid of odour.

This invention is applied in part to the oxidation or (as the patentee has caused it to be popularly called) the revivification of peroxide of iron after conversion into sulphuret of iron by contact with impure gas for its purification. Attempts have been made, with more or less success, to revivify spent oxide material in the purifying vessels through which the gas has been passed for its purification: but the practice is apt to cause a dangerous elevation of temperature. This evil is avoided by first filling up the gas purifiers which contain the spent material, or otherwise drenching it with water or other aqueous liquor, and by then forcing a current of air through it after it has become only so free from water as draining will make it. The oxide material to be thus treated should be prevented from passing through the sieves of the purifiers by coarse sacking or other suitable substance placed upon them before they are charged. It is not indispensably necessary that the ammoniacal solutions used in this part of the invention for producing free ammonia should contain only hydrosulphate. They may consist partly of ammoniacal carbonate, ordinary gas liquor or washings answering the purpose in a very satisfactory manner, and offering the additional advantage of being generally ready at hand. The said liquors, treated in the manner prescribed for solutions of hydrosulphate, notwithstanding the carbonic acid they contain, absorb with avidity both sulphuretted hydrogen and carbonic acid like the solutions of free or caustic ammonia; and by reason, first, of there being no sulphur left in them to give existence to the soluble sulphuret of calcium; and, secondly, of the insoluble nature of carbonate of lime, they admit of very easy conversion into entire solutions of free ammonia by treatment with lime. When gas washings are so abundantly produced as to contain but little ammonia to make them valuable, they will by this treatment with oxide be made so innocuous as to be admissible into the common sewers.

When ammonia, or any of its soluble combinations, is to be removed from gas by any fluid menstruum in which it is soluble, a modification of the double diaphragm scrubber is used for that purpose, which may be thus constructed:—Take a cylinder about three inches long, and of as many feet in diameter as may be requisite, closed at one of its ends by a disc perforated all over with holes about one-eighth of an inch in diameter, or somewhat larger, and about three-quarters of an inch apart, each of which may be partially plugged by a small nail. Place the short cylinder, with its perforated end downwards, within the case of a cylindrical common scrubber, so much larger in diameter than itself that a horizontal flanch a few inches wide, turned downwards from the top edge of the short cylinder, and fixed air-tight to a ring of angle iron on the inner surface of the cylindrical case, shall so divide the scrubber into two chambers, that no gas shall be able to pass through one or the other without passing through the holes in the perforated disc. Take a second short cylinder, closed at one end by an unperforated disc, and of a diameter intermediate between that of the former short cylinder and the case of the scrubber which contains it, and so fix it with its disc horizontally below the former one that, if it were full of water, the small perforations in the upper disc would be immersed in the water about an inch. Fix a short overflow-pipe, about two or three inches in diameter, water-tight, into some part of the unperforated disc, its upper orifice projecting upwards loosely through, and to the distance of about half an inch above the upper perforated disc, and its lower end descending, to be sealed by plunging into a cup of water supported some inches below the unperforated disc. Sufficient space must be left between all contiguous parts of the two short cylinders and their discs for the gas which is to be scrubbed in them freely to enter and pass between them, in order to ascend by the perforations of the upper disc. These holes must be in sufficient number for its free passage, and the discs in which they are made as horizontal as possible. Instead of one, there may be any greater number of these double diaphragms fitted to the scrubber, in which case only alternate overflow-pipes should be perpendicular to one another, in order that all their seal-cups may be sunk or let in water-tight to the unperforated disc next below them respectively. In vessels of large size, it is preferable to have the double diaphragms as much as 18 or 24 inches apart, with man-holes in the unperforated discs, or, in the case of the scrubber, for entering between them; and to make each perforated disc of moveable pieces, narrow enough to pass in and out by the man-holes, and confined to their places by the superincumbent pressure of square iron bars laid upon their edges.

The action of the scrubber is as follows, with respect to each of the double diaphragms it may contain. The liquid to be used is made to enter between the two discs of the diaphragms, to ascend through the perforations of the upper disc, and to overflow and fall down by the trap-pipe prepared for that purpose. Meanwhile the gas presented below the double diaphragm is constrained to descend between the two short cylinders, driving the liquid before it, then to occupy more or less of the space between the two horizontal discs, and finally to pass up through the perforations of the upper disc to become distributed through the liquid lying above it. By this arrangement any given portion of liquid may be kept at its work so long as it continues to do it effectively, because it can only quit the double diaphragm as fresh liquid arrives to cause it to overflow; and when several diaphragms work in the same scrubber the result is perfectly excellent, for in that case the gas comes successively into contact with fresh portions of liquid, each portion less exhausted of energy than that which preceded it, while the acting liquid, as it becomes more and more inert by its downward progress, is successively brought into contact with gas more easily acted upon because more impure.

Impure gas should be deprived of tar by passing through dry coke before it arrives at the double diaphragms, but to make provision against inattention in this respect, one end of a pipe curved at right angles is fixed flush into the bottom of each seal-cup, the other end of the pipe projecting through the case of the scrubber, and being stopped outside by a plug. The withdrawal of that plug, aided by steam admitted to the body of the scrubber, will speedily clear the seal-cup and diaphragm of any tarry matter that may at any time have accumulated; so that there will be seldom or never occasion to enter the scrubber by the man-holes for cleaning it.

The improved double diaphragm scrubber may be constructed in a variety of ways and forms, the gas being sometimes made to enter between the two parts of each diaphragm at its centre instead of at its perimeter; but whatever be the detail adopted for putting the principle into operation (the materials of which the apparatus is constructed being always suited to the nature of the reagents to be used in it), it may be applied with advantage to many purposes—such as the washing of gas with water or diluted acid, the strengthening of gas liquor or weak ammoniacal washings otherwise obtained, or the more important purpose of combining ammonia washing and water washing in a single operation.

When the apparatus is to be used for that twofold purpose, it is preferable to have it constructed with six or eight double diaphragms, as thereby not only may the gas have the full advantage of the ammonia washing, but also the ammonia may be wholly recovered for the market, increased in quantity and strength by a considerable addition acquired from the gas. For this purpose the diaphragms should be worked in two sets, the lower set being used with the ammoniacal water and the upper set with plain water—the entry of both liquids being regulated by stopcocks delivering to the top diaphragms of the sets respectively, and the water entering with just speed enough to wash back the soluble compounds of ammonia, so that they shall not even contaminate the water of the uppermost diaphragm. This water being relatively small in quantity, mixes with the ammoniacal liquor used on the lower diaphragms, and passes out with it in the ordinary way at the lower part of the apparatus.

Instead of being fed with a continuous system of liquid, any particular scrubber or set of diaphragms is sometimes flushed by an intermediate supply poured occasionally and suddenly from an elevated cistern into the space between the two parts of its upper diaphragm. There are many known contrivances for causing an elevated cistern to discharge itself rapidly after any desired interval, either of which may be adopted, but the following is preferred:—On knife-edges on the side of a cistern of convenient size, standing on the top of the scrubber and receiving a constant supply of the washing liquid, a scale-beam is placed, so curved upwards at its ends that the points of support are much below the centre of gravity. To the upper arm of the beam is suspended a bucket, so situated that the cistern, when full, overflows into it by a spout arranged for that purpose. One arm of the beam is connected by a wire to a large valve in the bottom of the cistern, commanding a pipe of corresponding size leading through the outer case of the space within the upper double diaphragm, either of the scrubber or of the particular set in which the liquid is to be used. The position of the beam must be so adjusted that the rising of the valve shall in effect considerably shorten the arm from which it is suspended while it lengthens the other arm; and that the rising of the bucket shall in effect considerably shorten its particular arm of the beam while it lengthens the inner arm: the effect of which is, that the movement of the beam cannot be commenced without being promptly completed. The weights of the moveable parts must be so adjusted that the bucket shall descend before it is quite full and ascend before it is quite empty; and there must be a provision for emptying it when down, which is effected by a stopcock in its bottom left so far open as to let the fluid out from it less rapidly than it enters, or by a valve which is opened on the descent of the bucket by the resistance of a support placed beneath it.

The volatile products of gas liquor, or ammoniacal washings, are distilled from any suitable distillatory apparatus into a close iron vessel half filled with a cold, saturated solution of sulphate of iron. It is preferable to use one of the known continuous processes of distillation and to cause steam to pass with the other volatile products into the metallic bath, which it cleanses of foul odours, and which are carried off by an eduction-pipe fitted to the cover of the vessel and leading to red-hot flues, in which they are effectually destroyed. When the solution of sulphate of iron is decomposed, it may be known by its ceasing to absorb ammonia; and at that time the contents of the close vessel are let out, and are mixed with several volumes of cold water, and the whole is run upon a filter (such as has been before described answers the purpose, with or without previous settling and decanting); the clear liquor is evaporated in any ordinary manner for the production of sulphate of ammonia, and the solid residue is oxidized, mixed with sawdust or other porous mate-

rial, or with the materials already mentioned with respect to the similar residue obtained by purifying gas with solution of sulphate of iron. Or, instead of mixing at first two separate products, the whole decomposed solution of sulphate of iron is placed in a flat iron basin on the top of retort-beds or flues, in gas-works where, without boiling, it can become sufficiently solid for convenient removal to other localities, in which the operations for separating it into two products may be more conveniently carried on.

The claim is for—

Distilling phosphorus from earthy compounds or mixtures containing phosphate of ammonia and carbonaceous matter.

The combination of the means described for obtaining simultaneously from the residue of the purification of gas by solution of sulphate of iron two products; viz., sulphate of ammonia and hydrated peroxide of iron, in a state of admixture with lime, magnesia, carbonate of lime, or carbonate of magnesia, or any two or more of them.

Obtaining ammonia and simultaneously combining it with the carbonic acid of impure gas by introducing hydrosulphate of ammonia into the gas, prior to or simultaneously with its entrance into dry purifiers, charged with materials containing iron in any state which enables it to abstract the sulphuretted hydrogen, and to undergo atmospheric revivification alternately with the subsequent removal from the gas of its ammonia and combined carbonic acid. But no claim is made for the washing or scrubbing of impure gas with ordinary gas liquors, as practised for the purpose of making them more rich in ammoniacal compounds, even though the gas be afterwards passed through a material containing hydrated or revivifiable peroxide of iron.

Converting solutions containing in large or small quantities of ammoniacal hydrosulphate, mixed or not with ammoniacal carbonate, into solution, either wholly or in part of free or caustic ammonia, by the agency of such oxides, or preparations, or mixtures, containing chemically-divided iron as will abstract the sulphuretted hydrogen, after saturating or fixing the bulk of the ammonia. Also admitting water or watery solutions to drench what are known in gas-works as porous mixtures of hydrated revivifiable peroxides of iron while in the purifying vessels, preparatory to forcing through those vessels a current of air for the revivification of the purifying material which they contain.

The purification of gas from ammonia, or ammoniacal compounds, by washing it in a scrubber, divided by one or more double diaphragms, each so constructed that its lower part is a basin to sustain the acting liquid, into which the upper and perforated part of the double diaphragm is immersed for distributing the liquid and the gas.

Receiving the volatile products from gas liquor, or ammoniacal washings, into a close vessel, containing sulphate of iron in solution, together with either the subsequent separation and evaporation of the resulting liquor into sulphate of ammonia, and the mixture and peroxidation of the iron precipitate; or, the evaporation by gentle heat of the mixed products of the distillation, as hereinbefore described.

372.—David Falconer, of 68, Causeyside, Paisley, for "*Improvements in the mechanical arrangement for raising and forcing of water or other fluid, air, or gases.*" Patent dated Feb. 9, 1857.

This invention consists primarily in causing the tube through which the fluid passes, or is made to pass, to oscillate.

This pipe, being double or forked at one end, and each fork being in communication with an elastic or collapsible chamber made of leather, india rubber, or other suitable material. In each chamber there is a valve opening inwards and communicating with the pipe descending into the fluid to be raised, and in each fork is a valve opening upwards; consequently, as the pipe or tube above the collapsible chambers is caused to oscillate, the fluid is drawn up into the chambers, and forced upwards or onwards at each oscillation of the pipe or tube. This arrangement will serve up to 60 or 100 feet, but, above that, it is preferred to use two plungers with valves opening upwards instead of the collapsible chambers. To effect a uniformity of action, air-vessels or chambers may be attached or communicate with the apparatus.

The claim is for the above-described arrangement or mechanical construction of machinery for raising and forcing water or other fluid.

377.—William Thomas Walker, of 55, King Square, St. Luke's, in the co. of Middlesex, civil engineer, for "*Improvements in apparatus used in gas-works for exhausting, forcing, transmitting, and regulating the flow of gas, and cleansing and warming gas apparatus.*" Patent dated Feb. 10, 1857.

The first portion of these improvements—namely, for the exhausting, forcing, and transmitting of gas—consists of a double-cylinder exhausting apparatus, with the compact and economical mode of combining and arranging the steam-engine power and other necessary appurtenances, for the purpose of giving motion and perfecting the working of the same.

The double-cylinder exhausting apparatus has two separate pistons working therein, to which motion is given by the steam-engine, or other power, acting upon a double crank, and thence by means of connecting-rods and piston-rods—the one crank being set at right angles to the other, or in such a position that one of the pistons shall be at half-way stroke while the other piston is at the beginning or termination of its stroke, for the purpose of causing the gas to flow constantly and regularly to and from the exhausting apparatus hereinafter so called in the specification. The exhausting apparatus may be worked by power from a steam-engine, or from any other source; it may also be constructed to work horizontally, vertically, or at any inclination.

It has four self-acting counterbalanced valves for inlets for the admission of gas, and four self-acting counterbalanced valves for outlets for the transmission of gas, working self-acting, as a vacuum or otherwise is created by the travelling of the pistons; and the exhausting apparatus is so arranged, that, should it be desirable, by reason of an accident, or when the quantity of gas to be exhausted or passed is considerably diminished, one part of the exhausting apparatus can be instantaneously stopped, with stopping or retarding the action or working of the whole apparatus. For this purpose is introduced four shut-off valves; and the patentee has also invented what he calls an equilibrium valve, two of which are used in the exhausting apparatus.

When it is desirable to stop the action of one part of the exhausting apparatus without stopping or retarding the action of the whole, it can be instantaneously done by opening the equilibrium valve and closing the two shut-off valves, shown on the drawings, connected with that part of the apparatus which is to be stopped. The equilibrium valve opens a communication between the top and bottom of the cylinder, which, consequently, feeds itself with gas from either end as the piston traverses.

The exhausting apparatus can be entirely shut off, both at its main inlet and outlet, when it is intended to pass the gas through the by-pass pipe by the four shut-off valves already described. They answer the purpose, and avoid the necessity and expense of main inlet and main outlet valves.

As the quantity of gas produced or generated in a gas-work is intermittent, and frequently varies considerably, it is essential that the exhausting apparatus, and the power by which it is worked, should be so arranged that it may be governed and regulated to meet any exigency that may arise. For this purpose the patentee has introduced a gas governor of peculiar construction, the gasholder of which is of a diameter of not less than 18 inches, communicating directly by direct action with the throttle-valve of the steam-engine, from whence the power is, in this case, to be derived, avoiding the complicated system of levers hitherto used, and by having the motion of the gas governor arranged so as to rise and fall very slowly, by very slowly admitting the gas into its interior, and also by having the governor constructed so as to give a long range of rise and fall; the lever connecting with the throttle-valve of the steam-engine also having a proportionate long range of motion, the action of the governor is made more sure and certain, and the friction and number of working parts greatly lessened, upon which the proper action of a gas governor in this case so greatly depends. The effect of this gas governor upon the throttle-valve is, that when the quantity of gas decreases, the gasholder will fall and partially close the throttle-valve, diminishing the speed of the engine; and when the supply of gas increases, the gasholder will rise, opening wider the throttle-valve, and causing the speed of the engine and exhausting apparatus to increase proportionately.

As it sometimes happens that the exhausting apparatus requires to be worked by a steam-engine not specially provided for it and devoted to its exclusive service, or by other power not produced by the agency of steam, and as the gas governor before described, regulating the admission of steam to the engine by the throttle-valve, would in such cases be inconvenient or inapplicable, the patentee uses a governor larger in diameter, of the ordinary construction, attached directly to a cone valve provided in the by-pass pipe. The effect of this governor is that, when the amount of gas generated decreases too low, it opens a communication from the main outlet pipe to the main inlet pipe, and causes the exhausting apparatus to feed itself with gas from the main outlet pipe in the usual manner, until more is generated, when it cuts off the communication.

While remarking on this part of the exhausting apparatus, it will be seen that the equilibrium valves before described are also peculiarly applicable, with a little attention, to meet the fluctuations in the quantity of gas generated or produced; for not only by the aid of the equilibrium valves can one part of the exhausting apparatus be thrown out of action, but the whole exhausting apparatus, even while in motion, may be instantaneously made to partially or completely feed itself back with gas from the top of the cylinder to the bottom, or from the bottom to the top, at every stroke.

One of the objections to exhausting apparatus heretofore constructed, which do not work in liquids, has been, that if the motion is stopped, and the exhausting apparatus allowed to rest for a time, the tar and impurities in its interior will become congealed, and the whole of the parts of the machinery thereby clogged and jammed up, so as to require to be taken to pieces and thoroughly cleaned before it can be set to work again. The inventor overcomes this objection entirely by the use of steam, which he obtains from the steam-boiler, or the steam supply-pipe to the engine, or from any other source. He uses a branch pipe furnished with a stop-cock to each part of the exhausting apparatus, and, thus blowing steam through, is enabled to dissolve all impurities, and thoroughly clean the exhausting apparatus at any moment during motion or otherwise.

In cases where the exhausting apparatus is of very large size, or where the fuel to generate the steam is scarce and expensive, the stroke of the steam-engines is made of the same length, or longer than that of the exhausting apparatus; and thereby the engines may be worked expansively by the addition of an expansion valve to each steam-engine, effecting great economy in the steam power provided.

The part of the invention relating to the warming and cleansing of gas apparatus, consists of an improved portable tubular steam-boiler, either made cylindrically and vertically, or horizontally, with a D-shaped or cylindrical-shaped body.

The portable tubular steam-boiler is arranged so as to be specially useful on a gas-work whenever hot water or steam are required for removing foulness, impurities, and obstructions from the pipes and apparatus; also for gas-works situated in cold climates, the operations of which are impeded by ice in the gasholder-tanks, freezing of water-lutes, the congealing of tar, naphthaline, and other impurities, which contract, choke, and make foul the passages of the pipes and apparatus.

The claim is for—

First, in that part of the improvements hereinbefore called the exhausting apparatus for the use and method of exhausting, forcing, and transmitting gas by double cylinders, or two combined cylinders with pistons working therein, with the four self-acting valves for inlets for the admission of gas, and the four self-acting valves for outlets for the transmission of gas.

Also, for the method shown and described of instantaneously throwing either half of the exhausting apparatus completely or partially out of action and working, either remaining half alone by the use of the shut-off valves and the equilibrium valves before described (which shut-off valves also save the necessity and expense of the main inlet and outlet valves heretofore used). Also of working wholly or partially, and of having complete control over the apparatus and the amount of gas passing in either or both of the cylinders by means of the equilibrium valves; and of being provided with a constant reserve to meet any exigency or accident that may occur on a gas-work.

The claim is also for the combination and compact mode of arrange-

ment of the exhausting apparatus with its pipes and connexions, and the steam power necessary to work it, and the method of making one framing support and carry the whole apparatus, including an extra duplicate steam-engine where required; and the means of throwing either steam-engine in or out instantaneously. Likewise the simple system, shown and described, of the gas governor's connexion with the throttle-valve, and the system of working the steam-engines by expansive force of steam on a gas-work for giving motion to exhausters.

Also, the method described of cleansing exhausting apparatus by the use of steam; and this part of the improvements is applicable not only to the exhausting apparatus herein described, but to all other exhausting apparatus.

Referring to the improvements in regulating the flow of gas, the inventor claims the general combination and arrangement of gas valves shown and described; the methods shown of opening and closing gas valves by means of a lever deriving its motion from an axis with the different methods shown of giving motion to the axis for the purpose of opening and closing gas valves; and the means described of protecting the valve and keeping it accurately to its facing; and this mode of protection which is claimed is also applicable to gas valves of any other description.

Referring next to the governor, the claim is for the method of working the counterbalancing beam on a hardened steel knife edge against a hardened steel surface, and the compact method of fixing the pressure-guages. With these exceptions, the claim is limited entirely to the cheap and effective mode of constructing a governor as shown and described.

Also, for cleansing and warming gas apparatus, a portable tubular steam-boiler and its appurtenances, and the general combination, arrangement, and improvement of its parts, as shown and described, for the special use of gas-works.

PROVISIONAL PROTECTION

HAS BEEN GRANTED FOR THE UNDERMENTIONED PATENTS.

1978.—CHARLES FREDERICK VASSEROT, of 45, Essex Street, Strand, London, patent agent, for "*An apparatus for measuring and registering the flow of liquids.*" July 17, 1857.

2018.—HENRY DOULTON, of Lambeth, in the co. of Surrey, for "*Improvements in the manufacture of earthenware, drain, and other pipes.*" July 22, 1857.

2039.—JOHN WALTER FRIEND, of Freemantle, Southampton, chronometer-maker, for "*An improved meter for registering the flow of water and other liquids.*" July 27, 1857.

2101.—GEORGE BROOKS PETTIT, and HENRY FLY SMITH, of Oxford Street, London, gas engineers, for "*An improved cap or cover for the glasses of gas and other lights.*" Aug. 1, 1857.

NOTICES HAVE BEEN GIVEN OF INTENTION TO PROCEED WITH THE UNDERMENTIONED PATENTS.

976.—JOHN HORACE TAYLOR, of 24, Alma Street, Hoxton, in the co. of Middlesex, engineer, for "*Improvements in regulating the flow of fluids.*" April 6, 1857.

1072.—JOHN SUDBURY and ALFRED WILLIAM LINSELL, of Halstead, in the co. of Essex, brass founders, for "*An improved gas regulator.*" April 23, 1857.

1337.—THOMAS LAMBERT, of Short Street, New Cut, and OBED WAKEFIELD, of 23, Lambeth Terrace, Lambeth, London, for "*Improvements in apparatus for drawing off water and other fluids.*" May 12, 1857.

Legal Intelligence.

GLOUCESTER ASSIZES, AUG. 12.

RUCK *v.* WILLIAMS.

Mr. HUDDLESTON, Q.C., and Mr. POWELL appeared for the plaintiff, and Mr. Serjeant PIGOTT and Mr. GREY for the defendant.

The plaintiff in this action, Mr. Ruck, was the occupier of the Montpellier Baths at Cheltenham, and he sued the defendant, Mr. G. E. Williams, the clerk to the Cheltenham Improvement Commissioners, to recover damages for the injury done to his furniture and philosophical apparatus by an inundation which took place on his premises on the 26th of July, 1855, in consequence (as was alleged) of the negligence of the commissioners in the construction and keeping of the sewers of Cheltenham. The defendant pleaded a plea of "Not guilty by statute," and called upon the plaintiff to prove his notice of action. This being done, it was objected that the notice was bad—first, because there was no sufficient cause of action; and, secondly, because it did not appear distinctly that the plaintiff intended to bring an action.

Mr. Baron MARTIN overruled the objection, and said he thought the clause respecting notice of action ought to be struck out of every Act of Parliament. It was a common scandal that such notices should be required.

William Simons proved the bursting of the sewer before the storm of the 26th of July.

Mr. *Ruck* proved that the sewer under the baths burst at the time of the storm of July 13. He then communicated with Mr. Smith, the overlooker of the new sewerage works, and told him, if any flood was to happen, the baths would be all under water Smith replied that the contractors had been spoken to on the subject, but that they had taken no notice of the communication, and he did not know who was the responsible person in the matter. The sewer was left in the same state from the 13th to the 26th of July, and gradually grew worse every day. On the 26th of July he received information that the sewerage matter was coming into his premises. On entering, he found there was sewerage matter as well as water. He found persons assisting to get the furniture away. He went to his galvanic room, and found all the tables upset, and nearly the whole of his valuable instruments covered with water. His two principal galvanic batteries cost him £40: the other instruments were very valuable. All the carpets were soaked in water, and perfectly spoiled. The water did not enter the baths by the front door at the time he arrived at the baths, and did not come in that way for twenty minutes afterwards: at that time all the furniture in the baths was covered with filth. He had a furnished house at 4, Bath Place, opposite the baths; he there found that the sewerage matter was coming in just the same way as at the baths. The damage done at the baths he estimated to amount to about £300: the damage to the instruments alone was £150. He could not replace the furniture under £150. The damage done at his house in Bath Place he estimated at £30 at least. During the time he resided at the baths, he remembered the river as high as the walls of Wellington Mansion. During the whole of the time he lived at the baths, they had never been flooded from the sewer; they had been overflowed with surface water, to carry off which he had devised a plan. After the injury happened, he went to the surveyor to the commissioners (Mr. Dangerfield), and asked him to come and look at the premises, but he declined to do so.

Charles Wood, assistant to the plaintiff, deposed that the depth of the sewerage matter in the room, he considered, was from 3 feet to 3 feet 6 inches. Up to the time of Mr. Ruck's arrival no water had commenced flowing through the front door. It was about twenty minutes after that, that the surface-water came in at the front door.

James North, brass-turner, was called to corroborate the last witness's evidence.

Mr. *George Powell*, furniture broker, of the Promenade, Cheltenham, deposed that he remembered the flood at Cheltenham on the 26th of July, 1855. His premises were flooded at the time. The water first came from the sewerage works.

Joseph Greville, in his examination, said: Clay puddling is a good thing in order to keep the brook-water from sinking. Concrete is better to protect the arch of the sewer when there is a running stream over it. The soil is rubbly. Looking at the position of the soil, concrete ought to have been used.

By Serjeant PIGOTT: The drain was very well made. As far as I know, it would have stood the test of any ordinary occasion. The dam was to turn the water over the portion that was not broke.

Re-examined: I don't think the sewer would have burst if concrete had been used.

Charles Williams: I am a bricklayer. Immediately after this sewer was burst, I was employed in repairing it. The repairs might have been managed in one day, and the concrete in another; it would have taken a couple of days to repair one hole. We were employed at it a week and three-quarters of a day, and it was not then finished. Concrete was the proper thing to use.

Cross-examined: Good clay puddle would hold water, but won't resist the stream—it will wash away.

By the JUDGE: It was the water inside that burst it. Concrete over the top of the sewer would afford more resistance than puddling.

Cross-examined: The concrete should be made of Portland cement. I was reckoning for two bricklayers, and labourers to attend them.

By the JUDGE: We were not continually repairing these holes.

Cross-examined: I assisted at three holes.

Re-examined: It would have taken a couple of days, with plenty of strength, to repair the hole in Wellington Street.

John Walter Wilkins: I was clerk to the late Metropolitan Commissioners of Sewers, and am now to the present Board of Works, and extensively engaged in the survey of sewers. I spend a considerable portion of my life in sewers. I came from the Chelt sewer this morning. I went to the place where the Chelt sewer joins the Bath sewer. The diameter was about 2 feet. I found there was no flap or valve. It is not on all occasions proper to have a flap or valve where the branch sewer joins the main sewers. The effect of a flap or valve would be to prevent the sewerage matter going up from the main sewer through the branch sewer. It would also prevent the effluvia going up. If that valve were not there, and the sewer blocked, it would have the effect of sending the sewerage matter up the branch, particularly if the highest part of the main sewer was above the level of the floor of the baths. I saw where the old sewer communicates with the branch. I found there a portion of the wood frame of the valve left in. With my experience I should have put a valve where the Bath Road sewer comes into the Chelt sewer. I saw the place where the sewer had been made good. The repair there might have been done in two or three days; it would not have taken 13 days.

Cross-examined: I should have put the flap to guard against the Chelt being subjected to periodical floods. I should have guarded against the chance of its being stopped below. I am aware that, except on the occasion of an accident, the water from the brook does not enter the sewer. A stoppage below might be expected in this sewer, and affect the outlet of the sewer.

The JUDGE: Is that a question you are going to raise for the jury, whether or not there ought to be a flap there?

Mr. GREY: No, my lord.

The JUDGE: Then why cross-examine?

James Macleary: I am a civil engineer and draughtsman to the Metropolitan Board of Works. The level of the highest part of the Chelt is about 11 feet above the floor of the baths. I certainly would have had a flap there. If the bath sewer had been properly flapped, it would have prevented the sewerage matter getting into the baths. There is no provision in the contract for any flap such as is required there. I recommended concrete to Mr. Dangerfield. I don't know whether that was after the works were done.

Cross-examined: I am qualified to superintend the construction of a sewer. I never did construct a sewer. I am a surveyor and civil engineer occasionally. It is better than half a mile from the baths to the highest part of the Chelt. There is 11 feet fall from the junction to the floor. The flap was to shut out the sewerage matter. I would have put a flap to every person's premises if they were below the level.

Re-examined: I would have guarded against a stoppage of the main drain, even supposing there had been no breakage. The sewer empties itself into the Chelt after partly passing through the tank. I was employed by Mr. Dangerfield to make a trigonometrical survey of Cheltenham, which was let by contract, and I carried it out.

The report of Mr. Dangerfield, borough surveyor, as to the completion of the works, was put in and read.

Mr. Dangerfield's report of July 31, 1855, as to the flood, was also read.

Mr. HUDDLESTONE said that closed the plaintiff's case.

The JUDGE: What do you suppose the case is?

Mr. HUDDLESTONE: In three respects the commissioners are liable: first, that they ought to have had a flap instead of leaving it open as they did, and that there was a flap existing in the former sewer; secondly, it was improper construction to require that the arches of the main sewer under the Chelt should be covered with puddling instead of concrete; and, thirdly, there was an unreasonable length of time in leaving the sewer unrepaired.

The JUDGE: My own impression is, that there is no cause of action.

Mr. HUDDLESTONE: The damming of this tank was put up by the commissioners and not by the contractors, and therefore the commissioners are answerable for this.

The JUDGE: I nonsuit the plaintiff, and give leave to him to move to enter a verdict for £170, for I don't think there is any liability. I leave it as a question of law to the Court of Error.

GUILDHALL, PLYMOUTH, JULY 30.

STEALING GAS.

John Yeo, landlord of the "Castle," wine and spirit stores, Union Street, was summoned by the Plymouth and Stonehouse Gas Company for surreptitiously laying, or causing to be laid, a pipe without their consent, whereby they were defrauded of a quantity of gas.

Mr. WHITEFORD, the solicitor to the company, conducted the prosecution; Mr. J. E. ELWORTHY was engaged for the defence.

Mr. WHITEFORD, in opening the case, said he was happy to state that offences of this description were of very rare occurrence in this locality—this, in fact, being only the second instance of the kind that had come under the knowledge of the company since its formation. The present charge, he said, was preferred under the General Gas Companies' Act; and by that Act they had the power of proceeding against the defendant by indictment, as was frequently done elsewhere, and in that case he would have been liable to a term of imprisonment. The company, however, were disposed to deal with the case leniently, and, instead of treating it as a felony, they had decided upon proceeding against the defendant, under another clause, for a pecuniary penalty only, viz., £5 for the offence, and £2 for each day the pipe was allowed to remain. If the defendant could offer any explanation which would absolve him from the penalties of the Act, he should be glad, not only for the sake of the man's own character, but for the credit of the town. The offence was one of a very serious and grave character, and, when detected, it was necessary, for the protection of the general body of consumers, who were interested in the prosperity of the company, that it should be visited with severity by the law. The company could not, of course, adopt that strict inspection into every hole and corner of a man's house which would be the only means of guarding them against such frauds, and consequently they were, to a great extent, open to imposition by dishonest persons; for in such cases the meter could be no guide to the actual consumption, because such treacherous and clandestine subterfuges falsified the whole account. Mr Whiteford called the following witnesses:—

Mr. *Fitch*, chief inspector of the Plymouth and Stonehouse Company, said: It is my duty to inspect the out-door works, and the supplies to private consumers. I know Mr. Yeo. He resides in Squire Terrace, Union Road. He is a licensed victualler. He has been a consumer about five or six years. On the 26th of March, 1856, he had an additional service-pipe laid on, to supply the lamp outside his door. [Plan produced, showing main service and branch pipes.] There are meters fixed on both pipes.

Mr. ELWORTHY: I don't mean to dispute that the pipe was outside the meter, and on the company's service-pipe.

Examination continued: I should be the person to superintend any alteration in the service-pipe. We have not consented to any alteration in the service-pipe nor to any connexion with it since March, 1856. The company do not supply private consumers except by meter. On the 15th of July, in consequence of information received from one of the company's officers, I went to the defendant's premises. I examined the service-pipes. Having disconnected the meters, I then applied a light to the gas-stove and to two burners in the shop, and found that they were still supplied with gas, although the supply through the meter had been cut off. I burned it about a quarter of an hour, to satisfy myself that it was not merely a residuum in the pipe. I could not get admission to the cellar then, and called again in the afternoon; and, not being able to get the key, I took up the grating of the front area, and got into the cellar that way. I then found a lead pipe connected with the company's pipe, as shown in the drawing. It was about three feet from the meter. I traced the pipe to the stove in the shop, and to the two burners over the window. A pipe which formerly supplied one of the burners, and which was connected with the meter, was stopped up. The connexion with the false pipe appeared to be very well done. There was a quantity of dust on the pipe, which led me to judge it had been done some time—possibly two or three months. I did not see the defendant on either occasion when I first called; but on the evening of the same day he called at my house, and said he had come about this affair. He said, "It was a very unpleasant business, but he was quite ignorant of it; for he had employed a man to repair his beer-engines, and got him to do the gas-pipe at the same time." I asked him who the man was. He said he did not know; for the man had left the town about three weeks, and had, he believed, gone to a situation at Birmingham. I pass the defendant's house almost every night, and have noticed the burners burning constantly. I can undertake to say I saw them burning at least a fortnight before the 15th of July. The same mode of supply was continued down to the 20th of July.

By Mr. ELWORTHY: I did not tell the defendant he was liable to a penalty of 40s. a day for every day he continued to use the pipe. I have ascertained that the pipe has since been disconnected. I did not caution him when he came to me that he had better remove the pipe at once. I was not willing to say more than was necessary. I told the attendant that the gas was burning without passing through the meter. I understood that the defendant was then at Ridgway, and that that was the reason I could not have the key. She said she would send to Mr. Yeo for it. The service-pipe is not Mr. Yoe's, it belongs to the company. The pipe was visible to everybody that went into the cellar. He did not tell me that he did not know the junction had been made; the words he used were that he had no knowledge of the affair. I understood that he wished me to suppose that he was ignorant of it.

What was your impression from what he said?

My impression was, that he *did* know it. (Laughter.) I consider this was a daring act, but one not very easily to be discovered, because the connexion was not open to a person's view on going into the shop. The stove on the counter burns all day. The officers of the company go without notice to inspect the meters; but the man who went there would not be likely to go below. If the gas had been turned off when the man came it might have gone on undetected for some time.

Mr. WHITEFORD: This is exactly my case; it was so artfully concealed that if precautions had been adopted, it would not be likely to be detected in the ordinary course.

Examination continued: The least expensive and most practical manner of supplying these burners would have been to have taken it from the meter inside the counter.

Richard Bennett, meter inspector, in the employ of the gas company. I went to Mr. Yeo's premises on the 15th July. I examined both meters. After the supply had been disconnected I saw the gas in the stove on the counter still burning. I had noticed the stove 6 months ago; but I never saw it lighted before. I reported it to the office; and in the afternoon I examined the premises with Mr. Fitch, and found the connexion made in the bend under the meter. The work appeared to have been done some time, as the soldering was discolored. The light would have been supplied more conveniently and at less expense by making the connexion above.

Thomas M. Somerville said the defendant called at the gas office to see Mr. Henderson. He said this is a very unpleasant affair of mine—I am quite unconscious of it. I asked how long he had had it up, and he replied about 8 weeks. I said, if he was unconscious of it, he should find the man who did it, and asked him where he was; but he said he could not find him.

Mr. ELWORTHY addressed the Bench for the defence. He did not deny the existence of the pipe, but he denied most positively that the defendant had any guilty knowledge of the affair, and contended that not a single fact had been sworn which would lead the Bench to believe so. He ridiculed the idea of the company's professed liberality, and believed that if they could have made it a felony they would have done so; they evidently believed he had no guilty knowledge, and that being so, he (Mr. Elworthy) would ask the Bench to believe that the fraud had not been committed intentionally, or with the defendant's consent.

The BENCH said the defendant must be aware he had not the slightest defence to offer. The fact could not be got over, that the pipe had been laid on, and for no other purpose than to abstract the gas, and they could hardly believe that he was ignorant of it. It was a kind of fraud that could only be placed in the same category as picking pockets, and deserved to be punished severely. The Bench, therefore, could do no other than inflict the penalty provided by the Act, viz., £5 for the offence, and £2 per day for ten days, making £25.

Miscellaneous News.

ACCIDENT AT THE CHARTERED GAS-WORKS, BRICK LANE.

About half-past ten, on Friday night last, an occurrence took place at the above works, situate in Brick Lane, St. Luke's, which for some little time caused considerable consternation in that locality. We have been favoured with the following facts, which may be relied upon as strictly authentic. It appears that in the course of the fearful thunder-storm which passed over the metropolis early in the evening, the cap on one of the cast-iron columns which supports the ends of the two girders was struck by the lightning. The cap was split, and the action of the gas-holder in descending, by the escape of gas for the public supply, caused one of the guide columns to be thrown over, bringing with it two of the girders connecting the columns, portions of which falling with great violence upon the crown of the gasholder, occasioned three extensive fractures of the plates, from which the gas immediately rushed forth in large volumes. The immense iron column fell with a fearful crash into the yard, and broke up into four portions, one of which, falling upon the roof of the adjacent retort-house, broke through the cast-iron principals and lantern, but happily without occasioning any injury whatever to the numerous workmen engaged at the time in the building.

At the time of the occurrence, the gasholder contained about 100,000 feet of gas (the total capacity of the holder being 340,000 feet). The ignition of the gas took place from a lamp in the yard, and occurred free from any explosion whatever, simultaneously with the falling of the girders and column, which gave the first intimation of any accident having occurred. For the space of about five minutes the whole of the metropolis was brilliantly illuminated by the immense body of flame that rose up high in the air. Several fire-engines arrived shortly after the outbreak of the flames; fortunately, however, the services of the firemen were not required, for, owing to the admirable directions given by Mr. Upward, the superintendent of the works, and the exertions of the men under him, the flames were subdued in a comparatively short period.

The means adopted for extinguishing this immense body of flame were as follow:—It was at once found that any application of water was perfectly useless, and the fractures being of very large dimensions, Mr. Upward, who had mounted on the top of the gasholder, personally placed several wetted boards over the apertures, so as to form a foundation for the application of wetted sacks, luting, and clay, which had the effect of extinguishing the flames in the short space of about ten minutes.

It is imagined that the damage to the cap of the column was occasioned by the fearful flash of lightning which fell about six o'clock on the above evening; but no indication of it was shown at the time, and not until the girders and column fell from their positions. The lights of the district supplied from these works were partially extinguished for only a few minutes, and were speedily relighted, when the supply of gas was continued as usual. The conduct of the officers and workmen on the premises at the time of the occurrence is spoken of in the highest terms by the superintendent, especially Mr. Musgrave, who was most active in his assistance. The following is the official report of the damage done:—

"Accident at the Brick Lane Station of the Chartered Gas Company, caused by the lightning, by which one of the columns of a gasholder was struck and fell. The gas for a short period took fire in consequence, but no person was injured, or any further damage sustained. The fire was entirely subdued in a short period by the company's men, under the direction of the superintendent.

(Signed) "A. UPWARD, Superintendent."

METROPOLITAN BOARD OF WORKS.

A Special Meeting of the Board was held in the Council Chamber, Guildhall, on Tuesday, the 4th inst., for the purpose of receiving and considering a communication from the First Commissioner of Her Majesty's Works, &c., transmitting a copy of the report of Capt. D. Galton, R.E.; J. Simpson, Esq., C.E.; and T. E. Blackwell, Esq., C.E., on the plan of main drainage submitted for his approval by the board on the 22nd of December last. Mr. THWAITES took the chair at twelve o'clock, and the notice convening the meeting was read.

The CLERK laid the above report before the board, with the letter which accompanied it from the Office of Works. The latter portion of the report, containing the "conclusions" at which the referees had arrived, were given in the last number of the GAS JOURNAL, pp. 373, 374. In his letter the First Commissioner stated that the appendix and plans referred to in the report of the engineers had not been received by him, but so soon as they were copies should be forwarded to the Metropolitan Board.

The reading of the report (which occupied two hours and three quarters) having been concluded,

The CHAIRMAN said: The members of the board will have seen that this report is sent to us without a single section; notwithstanding that fact, however, I thought it was desirable that you should be called together at the earliest possible period. Immediately, therefore, the report was received by the Government, I took steps to obtain a copy for each member of the

board. Unfortunately, however, as the House did not order the report to be printed, delay has occurred, and I shall not be able to have them till to-morrow morning. There is one other matter to which I may call the attention of the board. Observations were made some time ago as to the cost of the work hitherto: I then stated that accurate accounts had been kept of the expense of obtaining information for the referees, and I may now inform you that those expenses amount to £1510. 4s. It will be for you now, if you deem it prudent, to direct that the account of those expenses should be forwarded to the referees, that they may attach it to the account of their ordinary expenses.

Mr. CARPMAEL said, the board having received the communication from the First Commissioner of Her Majesty's Works, it behoved them to take some notice thereof. The communication contained a report made by those engineers to whom the First Commissioner had referred the plans of this board. Sir Benjamin Hall had not, in forwarding that report, expressed any opinion as to the merits of it or as to the plans which the board had adopted. The probability was that he had not even had a communication with the engineers, and might actually be uninformed as to the contents of the document which he had received from them. As he before said, it was incumbent upon this board to acknowledge receipt of the document; and, in doing so, it appeared to him that they could not omit some reference to the nature of the plan which it proposed. At the same time, he was most anxious that the board should not commit themselves in any way to a reply which could be deemed offensive to the First Commissioner. The manner in which he proposed to deal with the question was this: to acknowledge receipt of the document, and to request that the further papers referred to in it might be forwarded; and then to call the First Commissioner's attention to the fact, that the plans submitted by this board involved an estimated cost of £2,800,000, including the capitalization of the yearly working expenses; while the plan which the engineers consulted by him proposed would raise that amount to £5,400,000, without any provision for capitalizing the expenses. The board had no right to ask the First Commissioner what his views on that report were, because, after all, it was not before them in a way in which they could deal with it. Practically, as he was bound to suggest to the board, they had expended all their powers under the statute. They had prepared plans which, under the section of their Act, they had submitted to the Commissioner for approval; and they could not take up any new scheme, let it come from where it might, until the plans which they had themselves already adopted were either condemned or dealt with in some way or other by the First Commissioner. Therefore he did not wish in anything they said to commit either themselves or him to any specific course of action, especially as hereafter they would have to ask that they also might not be interfered with in the discharge of their duty. He, however, could not help feeling that the First Commissioner had no right whatever to ask for, and then seek (which he hoped he never would do) to coerce this board into, the adoption of plans matured under his own direction. But he had no right to expect that so clear-headed a man as Sir Benjamin Hall would adopt the report now laid before the board. There were two important points which must not be lost sight of. The first of these was that the report could not be carried out as a whole by the Metropolitan Board, because it proposed nothing less than to deal with the entire valley of the Thames, although that valley and the districts around it were largely external to the jurisdiction of the board. So far, then, as that part was concerned, he believed Sir Benjamin Hall would ignore the plan, because it was clearly beyond the statute. Then there was another very serious blot in this proposition of the engineers. The report had taken a long time to read, but he begged to assure the members of the board there was, after all, no very great change proposed in the plans submitted by their own engineer.

Mr. NICHOLAY rose to order. He thought it was not competent to any member of the board to discuss the subject at the present time.

Mr. CARPMAEL said he believed he was perfectly in order.

Mr. H. L. TAYLOR thought not. Under the notice by which the board was convened, he did not consider that any substantive motion could be entertained.

The CHAIRMAN said the notice convening the meeting stated that its object was to receive and consider a report and communication from the First Commissioner of Works, "and to pass such orders thereon as the board may deem necessary." The honourable member (Mr. Carpmael) had not as yet read his motion, and therefore so far he was quite in order, though it might be more convenient if he would state what it was that he intended to propose.

Mr. CARPMAEL said the motion with which he intended to conclude was in these words—"That, in acknowledging the receipt of Sir Benjamin Hall's communication of the 31st of July, he be requested to furnish this board with such plans and sections as may have been prepared by Captain Galton and Messrs. Simpson and Blackwell, to explain their recommendations; and that he be informed that this board, having on the 22nd of December last submitted to him plans for the interception of the metropolitan sewerage through covered sewers at an estimated cost of £2,836,600, regards with great apprehension any proposition to expend the sum of £5,437,265, of which it would appear that a sum of £3,144,300 is proposed to be expended in the formation of two open sewerage canals and works connected therewith, extending altogether to 76 feet in width and 37 miles in length, it being the duty of this board to cover all existing open sewers, and not to create further nuisance; and that the board particularly wish to be informed of the course which the First Commissioner proposes to pursue in respect to the plans submitted by this board."

Mr. H. L. TAYLOR again rose to order. Now that the motion had been read, he wished the chairman to rule whether the notice convening the meeting was sufficient to justify his honourable friend in proposing such a resolution. He was influenced in so doing, not by a wish to oppose such a course, but simply to save the time of the board.

The CHAIRMAN said, as to the expediency of any resolution, it was not for him to express an opinion; but certainly, according to the notice of meeting, the honourable member's proposition was perfectly in order.

Mr. CARPMAEL said, if his resolution included anything which was not before the board, that would be another matter; but that which he proposed to deal with was clearly and definitely brought out in the report which had been read.

Mr. OFFOR: Ought we not first to agree to receive the report, and afterwards discuss it?

The CHAIRMAN: The report is received, as a matter of course.

Mr. BURSLEM: The report just read is only half a report.

Mr. CARPMAEL said, if honourable members would only have patience, and give him their attention for a few minutes, he would briefly state his views, and then they could adopt any course they thought proper. It had taken a long time to read the report, but, practically, the changes which were proposed in it might be particularized in a very few words. In regard to the upper-level sewer on the North side of the Thames as proposed by this board, the engineers employed by the Government did not suggest any interference at all. The low-level sewer on the South side was also left intact by their report, so that in reality a very large part of the work decided upon by them was approved by all parties. The first variation proposed by the engineers consulted by the First Commissioner was an enlargement of the works. This board was at the outset pointed at, and in some cases ridiculed, for supposing that so large a scheme as they had propounded was required; but now it turned out that these eminent engineers objected to their plan because it was not large enough, and they said in effect that sufficient provision was not made for rainfall, nor for an adequate supply of water to the inhabitants of the metropolis. That was the first point. The next was, that the engineer of this board had not provided for the drainage of so large an area as he might have done by simple gravitation. The engineers from whom that report came had certainly made use of an expression with regard to this question which, to his mind, as a professional man, was most remarkable. It would be in the recollection of many members of the board, that he (Mr. Carpmael) had on former occasions occupied much of their time in dealing with this very point, and that he had insisted on the desirableness of getting the drainage of as large an area as possible to gravitate to the proposed outfall; but the engineers consulted by the First Commissioner said that a much larger area still could be dealt with in that way, and therefore, that on one side of the river the low-level sewer might be dispensed with, and yet a sewer be placed sufficiently near the Thames to carry off more than was now due to the low-level and middle-level sewers to the point of outfall. The fact was, they had not taken the area which the engineer of the board had dealt with; they had not taken his plans and dealt with them at all. They stated that on the map which they forwarded with their report, certain portions were coloured to represent the areas that might be drained by gravitation only, but they did not say where the lines of sewers were to go to take the drainage; and it could readily be understood, that if there were valleys within those high lands, the drainage of those places could not be effected by gravitation. They had not, as he said, provided for this necessity; but Mr. Bazalgette had done so, and had arrived at what he (Mr. Carpmael) believed was the maximum area which could be drained by natural means.

The CHAIRMAN: Would it be wise to discuss the details of the question until we have the sections?

Mr. Deputy HARRISON: I do not know whether the honourable member is in possession of information which other honourable members are not favoured with, but it appears to me that we have no evidence that Sir Benjamin Hall has adopted the report of these engineers at all.

Mr. WARE: I apprehend that even such a question as that cannot arise at all. Sir Benjamin Hall has no power to adopt any plan until it has first been decided upon here.

The CHAIRMAN: There is no question that the honourable member (Mr. Carpmael) is strictly in order in dealing with any question arising out of the report. It is simply a matter of expediency whether he can so well discuss the details now as when the sections are before us.

Mr. TURNER urged that the general discussion should not be taken till the board had further information.

Mr. CARPMAEL said he would bow at once to the chair, and refrain from entering into the details of the report. But there was one point upon which, as they had every particular that could be furnished now before them, he might be allowed to touch; and he was the more anxious to do so because, as it appeared to him, it was one of the greatest blots that could exist in any plan for the drainage of the metropolis. The engineers to whom Mr. Bazalgette's plan was referred stated that no method could be adopted which was not based upon the principles laid down by Mr. Bazalgette, and all that they proposed to do was to make certain alterations in it. And what were those alterations? They discarded the notion of having the outfall at B*, and, in place of that, recommended that an open reservoir canal—an enormous, lengthened, open reservoir—should be dug for the reception of the whole of the sewerage of the metropolis. It was to be 37 miles long (*i.e.*, rather more than 18 miles on each side of the river),—the two together about 76 feet wide,—and entirely open and uncovered, except where it passed through towns, when it was to be bridged over. They proposed in some way or other to convey water out of the Thames (at Plumstead on the one side, and Barking on the other) into these canals for the purpose of diluting the sewerage in them; and, so diluted, the sewerage was to flow in two streams, parallel with the Thames, until it arrived at Sea Reach on the South side, and a point nearly opposite on the North, where it was to be poured into the river in the manner in which it came there. The engineers had exhibited great courtesy to and concern for the inhabitants at Erith, but whether those gentlemen and the inhabitants of Gravesend, Grays, and other places, would be satisfied to have such a canal as had been described coming up to their very doors was more than he (Mr. Carpmael) would undertake to say. But they were told that, because the sewerage thus exposed would be diluted with a large quantity of water, therefore it would not be at all offensive to any one. Strange to say that they could not get much water in this canal at high tide, except by pumping; and yet, if they allowed the sewerage to flow at once into the Thames 15 feet below the surface, as proposed by Mr. Bazalgette, it would, even as near as Erith, be diluted with about 500 times its bulk. He asked the board, therefore, in acknowledging the receipt of the report, to communicate to Sir Benjamin Hall the surprise which they felt that such a proposition should be made to them. It would be for the First Commissioner to deal with this plan as he thought proper; but he (Mr. Carpmael) thought that the country at large, and the metropolis in particular, ought to know what the points of contrast were between the works proposed by this board, and those contemplated by the professional men to whom Her Majesty's Government had referred the subject.

Mr. F. DOULTON seconded the motion.

Mr. TURNER said the first part of the resolution proposed that they should receive and acknowledge the report, and ask for plans. He perfectly agreed in that; but that they should go further, and offer an opinion upon the merits of the report, was, in his opinion, exceedingly objectionable, and wholly useless. A report from such eminent men as Captain Galton, Mr Simpson, and Mr. Blackwell, was of sufficient importance to demand a full consideration before it was dismissed as impracticable or impolitic; and the board were not in a position to deal with it at all until the promised appendix and sections were forwarded to them. To anticipate any discussion which might then arise, and rush headlong to a decision at once, would, to say the least, place the board in an unfavourable position with the ratepayers. It would seem to them that the great desire of the board was to find fault with the First Commissioner, and to throw obstacles in the way of carrying out any plan which did not emanate with themselves. He would therefore move, as an amendment, "That the receipt of

the report be acknowledged, and the First Commissioner be requested to furnish the board with the plans and sections referred to in it."

Mr. DENNIS seconded the amendment, believing that it would be a very rash step at present to adopt any motion which would involve an expression of the opinion of the board upon the merits of the report just read. They ought not to show any feeling of opposition against Sir Benjamin Hall and his engineers. The character of the board was at stake, and it might turn out ultimately that the plan now recommended was the only one that could safely be undertaken. There were not many practical men of engineering ability in the board, and he suggested that, before they gave an opinion upon so large a subject as that now before them, such men as Mr. Hawkshaw or Mr. Hawksley should be consulted.

Mr. BURSLEM supported the amendment.

Mr. Deputy HARRISON disliked both propositions, and should vote against both. As he comprehended it, the matter stood thus: A polite communication had been sent by Sir Benjamin Hall accompanying a proof copy of a report by certain engineers, and an intimation was given that plans and sections were being prepared, and would be ready in a few days, which plans were necessary to the full understanding of the report. Surely, under these circumstances, the board ought not to pass a resolution calling upon the First Commissioner to send down anything. He had already done all that lay in his power; he had furnished a copy of the report, even before it was presented to Parliament, and it was not treating the right honourable baronet as a gentleman in his high position ought to be treated, to suppose that he would not send to the board all the further information which might reach him on the subject of that report. Why should there be all this breathless haste, then, to pledge the board against one part of the plan before it could possibly be entertained as a whole? The course he would recommend was to request the chairman to acknowledge receipt of the report, to have the same printed and circulated, and, after the lapse of a few days, convene a special meeting to take it into consideration.

Mr. BIDGOOD said he must vote against both propositions, because he did not wish to place the board in a false position. They at present had an approved plan of their own before them, with an outfall for the sewerage at B*; that was the only plan upon which they had been up to the First Commissioner, and, for ought they could say to the contrary, that plan might come back with his sanction. To send up to the First Commissioner, therefore, and ask for additional plans would be, to say the least, most injudicious. Then, on the other hand, let not the board take a step which would wear to the public the appearance of a hostility to Sir Benjamin Hall —which he was quite sure did not exist—lest the public should begin to say, "So long as there are two jurisdictions there will be constant conflicts of opinion, and the work will always be retarded."

Mr. H. L. TAYLOR was afraid that his friend, Mr. Carpmael, who was generally in the right, had placed the board in a position on this occasion which, if they fell in with his views, will be highly derogatory. He hoped the board would not be led into the expression of any opinion upon the merits of the report now before them. Sir Benjamin Hall had a duty to perform; and though, as he (Mr. Taylor) could show, he had no doubt exceeded that duty, the present was not the proper time for going into the matter. He would simply say that plan B* was before the First Commissioner, and he had no right to hug up that plan till he could see how the *Times* and *Morning Star* regarded it. He (Mr. Taylor) did not wish to ask a favour of the First Commissioner—indeed, he was the last man from whom he would accept one if offered—but he must contend that, until he had discharged himself from B*, he had no right to take up with another plan. The First Commissioner had, as he thought, imprudently hurried the report which he received from Captain Galton and others into his paper, the *Observer*, and that had furnished food for the *Times;* and the best thing the board could do was to leave him alone, and not seek to put him further in the corner than he had already put himself. At the same time, he would do the right honourable baronet the justice to say that he had always furnished documents to this board the moment he had received them, and no doubt he would do so again. He hoped, therefore, the propositions now before the board would be withdrawn, and something else submitted upon which they could be unanimous.

Mr. F. DOULTON did not see either difficulty or inconsistency in adopting the motion, which simply asked for plans and expressed an opinion upon one very great blot in the report which had been sent to them. It was quite impossible to come to a positive decision whether they would receive or reject that report at present, but, with reference to the particular point referred to by Mr. Carpmael, they already had all the information they could possibly obtain. The report gave the fullest details respecting the offensive open ditches on both sides of the river which it was proposed to construct, and no plans or sections which might hereafter be forwarded could elucidate that matter in the slightest degree. The proposal to make two open sewers some twenty miles in length was, in the first place, contrary not only to the spirit but to the very letter of the Act of Parliament. The 135th section of the Metropolis Local Management Act expressly provided for the covering over of all open sewers, and, in the face of that enactment, it seemed to him that they ought at once to express an opinion upon the report of Captain Galton and his colleagues. They did not want plans and sections to enable them to say that the Act of Parliament prohibited the construction of any such works, and that their duty was not to create but to abate nuisances. It was absurd to suppose that those persons who had been objecting to the former plans of the board because they proposed to discharge the sewerage into the river, diluted to so large an extent as it was proved it would be, were to be content with two large open drains, each 40 feet wide, and running nearly 40 miles through a district which, in the course of a few years, would be thickly inhabited. The board ought, therefore, not to hesitate one moment about adopting the motion now before them, that so they might at once give to the public an indication of their opinion that such works would be a great evil, and that this part of the report, at all events, was stamped with their disapproval.

Mr. DENNIS: What! before you know what it is?

Mr. DOULTON replied that the board would be in possession of no new facts on this point when the promised plans and sections were to hand. It appeared to him that Sir Benjamin Hall was in a difficulty, and so was the board. He himself had thought much of this question during the last few days, and had anticipated with great anxiety the production of this report. Every one who was in the habit of passing up and down the river daily, must be often struck with the imperative necessity there was for something being done; but now, instead of mending the evil, they had a report presented to them by which it was proposed to perpetuate a monstrous nuisance at an expense of six millions of money. The question would by and by arise, Where is the money to come from? but with that at present they had nothing to do. It was well known that he was not one of those who favoured the plan of the board which was sent up to Sir Benjamin Hall, but he must say that he would gladly accept that in preference to the one proposed by the Government engineers, believing it to be in all respects far superior.

Mr. OFFOR, while feeling the great importance of an early settlement of the long-vexed question of London drainage, was opposed to a decision being come to at the present moment. They could only now deal with the question in a piecemeal way, which would be far from satisfactory to themselves or to the public.

After some remarks by Messrs. Howes, Nicholay, and D'Iffanger,

Mr. CARPMAEL withdrew his motion, and Deputy HARRISON his amendment, and a resolution to the following effect was adopted:—That the receipt of the report be acknowledged, and that the same be printed and circulated amongst the members of the board; and that, on receipt of the plans and appendices referred to in the communication of the First Commissioner, seven days' notice should be given of a special meeting of the board to take the subject into consideration.

The board then adjourned.

EQUITABLE GAS COMPANY.

A Special Meeting of this Company was held at the Offices, John Street, Adelphi, on Tuesday last—Mr. HOLDSHIP in the chair.

The SECRETARY read the following report of the directors:—

Gentlemen,—The circular just read having been sent to each proprietor, it is presumed you are all aware for what purpose the directors have invited you to meet them here this day.

We annex for your information a statement showing the extraordinary increase in the make of gas by your company for the years 1844, 1850, and 1856:—

	Gas made.	Gas Rental.
1844	160,000,000 . .	£33,000
1850	180,000,000 . .	38,000
1856	291,000,000 . .	49,000

It is now an admitted fact, that the well-doing of every gas company greatly depends upon an economical distribution of the gas made, and which is entirely contingent upon the mains being sound, and of sufficient capacity for a good supply to be delivered to the consumers at a moderate pressure; for, inasmuch as the leakage is nearly in proportion to the pressure, it is greatly to our interest to deliver the gas to our consumers at a moderate pressure; and this we were unable to accomplish during the last winter from the large, increasing demand for our gas. It is, therefore, to remedy the present want, and to provide for the probable requirements for a long period, that your directors have determined on laying a new 30-inch trunk main from the works at Thames Bank to Charing Cross.

To defray the cost of the proposed new main, and the works relating to the same, your directors recommend that they should have power to raise the sum of £12,000, by the issue of debenture bonds at a rate of interest not exceeding 5 per cent., in conformity with the company's Act of Incorporation.

The CHAIRMAN said he had nothing particular to add to the report which had just been read. It would be recollected that he drew the attention of the shareholders to the subject at the meeting in November. The period had now arrived when, in consequence of the increased consumption of the company's gas, additional works were required; and he hoped the meeting would sanction the proposal the directors had made, and accord the requisite sum of money for the purpose.

Mr. RHODES asked if it would not be much better to take power to borrow £15,000 at the present time? Supposing £10,000 only to be required at present, of course the other £5000 would not be borrowed, but the power to raise it would be still in the hands of the directors by the time they wanted additional gasholder room. That, perhaps, would cost £18,000, but then the directors would only require power to borrow £15,000 more, when they called the shareholders together again.

Mr. MARTELLI said the meeting had been called together for a particular purpose, and, though the shareholders present might bind themselves in reference to some other point, they could not bind the absent shareholders. Having convened the meeting by circular to raise money for a particular purpose, it would not be fair or legal to take power to raise money that might be applicable to any other purpose than that specified. It would not be in accordance with the Act of Parliament, nor would it be morally right or fair.

Mr. RHODES: You cannot tell whether this present work will not cost you more than you suppose.

Mr. VANDEWALL said the directors had made careful calculations as to the sum of money necessary for the proposed works, and they considered that they would cost from £9000 to £10,000. They had no doubt that the new main would be constructed for a sum not exceeding that amount; but, knowing that it was wisdom at all times to be a little guarded, they proposed to raise a sum not exceeding £12,000. If, however, they did not want the whole of that, of course they would not borrow it. They simply mentioned a sum, more than which could not by any possibility be required for this special work. With regard to the gasholder accommodation, of course estimates would have to be prepared, and a clear statement laid before the shareholders as to the probable cost, and it would be of very little use for the meeting now to give the directors power to borrow £4000 or £5000 in contemplation of works that might not be wanted for another twelve months, and in reference to which another meeting must be called.

Mr. BOX felt quite surprised that a matter should be mooted which had nothing to do with the special object of the meeting, and said it would be quite out of their power to entertain any such proposal as that made by Mr. Rhodes. He had every confidence in the directors, but he was not of that class of persons who would continue to raise capital upon capital; for it should be remembered that, whatever capital the company possessed, it was a perpetual burden until it was removed, and the debentures were as much capital to pay upon as were the shares that were paid up. They could not, however, reduce the shares, though they could the debentures. He thought the directors had acted wisely in not making too large a demand for the present. It should be remembered that the large main would relieve the gasholders wonderfully, and they did not know when another would be required. If the directors found, however, that the business was increasing (as he hoped it would), and that there was a necessity for erecting another gasholder, they would have an opportunity of intimating that fact at the next half-yearly meeting. It was not necessary now to enter upon the matter prospectively—"Sufficient unto the day is the evil thereof." When money was wanted for the purpose, he had no doubt the shareholders would readily grant what was required. He did not think they could do better than adopt the recommendations of the directors, and he therefore proposed that the report which had been read be received and adopted, and entered on the minutes.

Mr. RHODES seconded the motion, which was unanimously adopted.

The CHAIRMAN: I am very glad that the shareholders approve of what we have done in reference to this matter. I think I may give Mr. Rhodes an intimation that we shall certainly want another gasholder next year. I merely mention this to the proprietors that they may be prepared when the proposal comes before them, just as I prepared them in reference to this main at the last meeting.

Mr. MAUGHAN proposed that the directors be empowered to borrow, under the provisions of the Act of Parliament, any sum not exceeding £12,000, at an interest not exceeding 5 per cent., at such times and under such regulations as they might think fit.

Mr. RHODES seconded the motion, which passed unanimously.

Mr. BOX suggested that money might be obtained at a lower rate of interest than 5 per cent., and——

The CHAIRMAN expressed a hope that Mr. Box would himself advance a portion at a reduced rate.

Mr. BOX proposed a vote of thanks to the chairman and the board of directors, for their continued attention to the interests of the company. He was quite satisfied with the care and ability with which they had managed the company's affairs, and believed that they deserved the fullest confidence of the shareholders.

Mr. RHODES seconded the motion, which was unanimously adopted.

The CHAIRMAN said he was greatly obliged for the vote of thanks, and hoped the directors would continue to merit the confidence of the shareholders.

The proceedings then terminated.

REPORT AND BALANCE-SHEET OF THE PHŒNIX GASLIGHT AND COKE COMPANY.

The following is the report to be submitted on the 19th of August, 1857, to the proprietors of the Phœnix Gaslight and Coke Company, for the half year ending at Midsummer, 1857 :—

Your directors submit to your consideration a report of their proceedings, and the trade account during the half year ending at Midsummer last, together with the balance-sheet at that period.

Since your last meeting your directors have been much engaged in carrying out extensive additions to your Greenwich Station. The renewal of the wharf wall on the creek side is being continued. A considerable extension of the ground into the river Thames is being made, and a tank (to contain a new gasholder) is in course of construction. An old gasholder has been renewed and doubled in capacity. New storehouses are being erected, and the station-meter house is being rebuilt. The supplies of gas to the higher and lower grounds have been re-arranged, and made independent of each other. Large mains have been laid through the town in place of small and faulty pipes, which have been taken up. Extensive repairs have been done to many of the gasholders, and the one first erected at the Kennington Lane Station is still in the hands of the workmen.

Your directors regret to report that coke has sold during the half year, and is still selling, at an extremely low price.

Your directors, considering that the time has arrived for the commencement of a permanent investment fund, as a provision for contingencies which may hereafter arise, and especially for the purchase of the freehold of the present premises, both at Bankside and Wellington Street, or the re-construction of the works there upon other sites, have set apart the sum of £500, which they purpose to invest, as from time to time may be considered best, together with such further sums as circumstances will allow, and all interest accruing thereon.

During the last half year a net profit of £15,782. 10s. has been realized, out of which your directors recommend that a dividend at the rate of 3½ per cent. for the half year (being £15,210), together with the income-tax on the profits (being £533. 7s. 2d.), or a total of £15,743. 7s. 2d., be declared, leaving a sum of £39. 2s. 10d. to be added to the balance of £12,077. 17s. 4d., making a balance of £12,117. 0s. 2d. undivided.

(Signed) J. E. JOHNSON, Chairman.

ABSTRACT OF THE TRADE ACCOUNT FOR SIX MONTHS, ENDING MIDSUMMER, 1857.

Dr.				*Cr.*		
For coals used			£26,246 5 4	By rental for light		£56,658 15 7
Tradesmen's bills for materials used			6,326 18 4	Coke made for sale		11,086 14 1
Law			8 4 0	Breeze do.		253 7 3
Retorts used			590 7 6	Tar do.		1,044 19 9
Meter—				Ammonia do.		790 1 1
Repairs	£ 816 1 3			Interest received		422 3 4
Fixing	462 15 0					
Depreciation	604 10 0					
		1,883 6 3				
Rent, rates, and taxes		1,811 19 0				
Directors £750, auditors £50		800 0 0				
Salaries		2,752 2 5				
Wages paid		8,738 14 9				
Bad debts and overcharges		631 0 6				
Investment-fund		500 0 0				
Reserve for depreciation on plant and leasehold property		4,184 13 0				
Net profit		15,782 10 0				
		£70,256 1 1				£70,256 1 1

ABSTRACT OF THE BALANCE-SHEET, AT MIDSUMMER, 1857.

Dr.				*Cr.*			
For capital of 9000 £60 shares, at £52 each, paid up			£468,000 0 0	By amount of plant at Christmas last			£418,469 1 5
Unpaid dividends			246 7 1	Less—			
Unpaid tradesmen's bills			8,179 3 8	Reserve for depreciation of plant and leasehold property			4,184 13 0
Investment-fund			500 0 0				£414,284 8 5
Balance of profit and loss :—				Add—			
Undivided balance	£12,077 17 4			Expended this half year in extension of works			2,769 19 0
Half year's profit	15,782 10 0						£417,054 7 5
		27,860 7 4		Amount due from sundries :—			
				Midsummer quarter	£20,178 19 5		
				Arrears	5,707 2 4		
				For total rental	£25,886 1 9		
				Do. for coke	1,695 17 7		
				Do. breeze	118 16 0		
				Do. tar	500 19 11		
				Do. ammonia	312 8 7		
				Do. sundries	2,001 18 8		30,516 2 6
				Stock of coals	£5,645 5 0		
				Do. coke	15 15 0		
				Do. breeze	14 17 0		
				Do. tar	165 18 0		
				Do. ammonia	48 4 0		
				Do. retorts	959 1 6		
				Do. meters	12,859 17 0		19,708 17 6
				Balance at treasurer's	£7,506 10 8		
				Do. at interest	30,000 0 0		37,506 10 8
		£504,785 18 1					£504,785 18 1

LAMBETH NUISANCES.

There are worse nuisances in Lambeth, it appears, than the Vauxhall Gas-Works—nuisances, too, which, though confessed, cannot be put down. It will be recollected that a case in which Mr. Roffey, the vestry clerk of the parish, on behalf of the vestry itself, has been the complainant, and Messrs Pearce and Walling, the owners of premises in Bowling-green Street, near Kennington Cross, the defendants, has on several occasions occupied the attention of Mr. Elliott.

The premises in question are used for the purpose of smelting antimony, a business formerly established by Robson, of Crystal Palace notoriety; and the vestry adopted the proceedings against these owners under the 27th section of the Nuisances Removal Act, for an intolerable annoyance and nuisance experienced by the respectable inhabitants and ratepayers in its vicinity, caused by the gaseous exhalations proceeding by day and night from the chimney and roof of the building. As far back as the 3rd of June, Mr. Odling, the medical officer of health for the parish, gave a certificate of the existence of the nuisance; and, on the first hearing of the case at this court, Dr. Purcell, and other gentlemen in the vicinity, gave a most fearful description of its effects, and the sufferings which themselves and their families had endured through it. Dr. Purcell said that such were the deleterious and pernicious effects of the vapours emanating from the manufactory that the fruit-trees in the gardens and everything green in the vicinity became blighted and destroyed; and that, in addition, the dwelling-houses were almost constantly filled and impregnated with pestilential exhalations, producing in many of the residents, nausea, sickness, and serious injury to the membranes of the throat.

The defendants admitted carrying on the business of antimony smelting on the premises, but contended that, under the 44th section of the Nuisances Removal Act, they were not liable to a conviction, as the trade carried on by them was expressly exempt from the operation of the statute.

Mr. ELLIOTT had no doubt whatever that the works carried on by the defendants had been productive of a serious nuisance, and should not be permitted in a densely-populated or crowded neighbourhood; but on referring to the 44th, or concluding, section of the Act, in which the following words by some extraordinary means crept in, viz. :—"And the provisions of this Act shall not extend or be construed to extend to mines of different descriptions, so as to interfere with or obstruct the efficient working of the same, or to the smelting of ores and minerals, or to the manufacturing of the produce of such ores and minerals," he felt the difficulty of convicting or making any order for the removal of the nuisance complained of.

On behalf of the parish, it was contended that the section of the Act just quoted did not apply to such works or premises as those carried on by the defendants, and that the words had only reference to mines, which were just before mentioned; and the point being one of importance to the vestry, and the nuisance of serious evil to the inhabitants, Mr. Roffey submitted a case to Mr. W. N. Welsby, in which he requested that learned gentleman's opinion whether the smelting works of the defendants came within the operation of the 44th section of the Nuisances Removal Act, and this is the opinion of that learned counsel :—"I am of opinion that the smelting works and premises in question come within the operation of the 44th section, and are by it exempted from prosecution under the Act. It is highly probable that the framer of the Act intended the exception to apply only to mines and to the smelting of ores and minerals, or the manufacture of the produce of them, in connexion with the mines themselves; but I think the words, especially in a penal clause, cannot be so limited. The exception is made to apply in terms and without any limitation in respect of local situation to mines or to the smelting of ores and minerals. It is admitted that the process complained of consists in the smelting of a mineral—viz., antimony. It appears to me, therefore, to be included in the exemption, as it is framed, although, as I have said, I have little doubt that this construction is at variance with the intention of the person who drew the Act." This opinion being confirmatory of that entertained by the magistrate, has settled the case.

The parties attended before Mr. Elliott on the 13th instant, and the summons was dismissed; but the magistrate at the same time informed Mr. Roffey that there was nothing in the Act to prevent his indicting the defendants, if such a course should be found necessary.

GENERAL CONSIDERATIONS ON THE MATERIALS EMPLOYED IN BUILDINGS ERECTED IN SEA-WATER.

Translated from the "*Annales des Mines.*"

By M. CHATONEY, *Ingénieur-en-Chef des Ponts et Chaussées,*
AND
M. RIVOT, *Ingénieur des Mines,* and *Professeur à l'Ecole des Mines.*

For some time past engineers and chemists have been engaged, with more or less success, in the consideration of the employment of hydraulic materials in marine constructions—an important question, which seemed to have been completely solved by the scientific and persevering researches of M. Vicat.

In various ports there have been observed examples, unhappily too numerous, of the decomposition of mortars which had been made up and used under widely different conditions. The decomposition is at one time almost immediate, at another time very slow: sometimes it does not show itself until after the lapse of a great number of years. It presents itself under very different aspects, either as a softening or disintegration more or less gradual, or as a swelling and scaling off, which proceeds from the surface towards the centre.

In many cases, the mortars which offer a long resistance to the action of the sea-water are, or become, porous, and would thus permit the infiltration water, which is an extremely serious disadvantage in many constructions—dry docks, for example; and moreover, as we shall shortly see, this porosity is in itself a cause of gradual decay. The instances of decomposition reported of late years have been so numerous, that many distinguished engineers have stated it to be their opinion that it is impossible to protect the mortars which have ordinary lime for their base from the action of the salts contained in the sea-water; and that the durability of such constructions can only be hoped for, under the circumstances, where their surfaces are protected by marine incrustations.

We cannot concur in this opinion, which appears to us too absolute. No doubt the vegetations and shelly incrustations must considerably favour the preservation of the mortar; but it is not to that alone that we must look for the true elements of durability. By a suitable selection of materials, and a particular method in the preparation and the use of each of them, it is possible to obtain mortars of sufficient density, capable of resisting the mechanical and chemical action of salt water, and resembling those used by the ancients, which, after the lapse of ages, still present a sufficient solidity to resist every attack of this description.

If any of the accidents which have been reported in recent constructions may be attributed to a want of judgment in the selection, preparation, and application of the materials, the far greater number of instances of the decomposition of mortar are to be explained by the still more imperfect knowledge of the chemical composition, and of the particular mode of application suitable to each kind of material employed.

The analysis of those mortars which remain uninjured for several years, and the observation of well-established facts in practice, are sufficient of themselves, by their reciprocal corroboration, to lead us to a complete and ready solution of the question, by pointing out the chemical composition to be sought for in the materials, and the precautions to be taken in their preparation and application.

For some time past, series of practical experiments have been made in several ports, by immersing in the open sea, and in tubs of sea-water, blocks of mortar made up in the ordinary manner with the materials proposed to be used. It would appear from the protracted experiments conducted at Hâvre, that the conditions of decomposition and of preservation, as regards the mortar in the tubs, do not correspond with those observed in the case of that exposed in the open sea. We need not be surprised at this, as the conditions are essentially different, as regards either decomposition or preservation. This mode of observation is nevertheless extremely useful, as we shall show in the course of our notice; but it is not conclusive, and we must not attribute more importance to it than it really possesses.

We have been led to divide our work into two parts: the one, theoretical; the other, practical.

The former, containing the analysis of a large number of mortars and hydraulic materials, and the discussion of the immediate conclusions to be drawn from these analyses, is to be ascribed to M. Rivot; the second, drawn up by M. Chatoney, consists of observations and experiments on the mode of preparation and on the application of hydraulic materials.

While we thus divide our work in such manner as to apportion to each of us the part best suited to his particular province, we desire to preserve the unity of the whole, all the details of which we have carefully discussed together.

Our inquiries were commenced several years since, and we have devoted to them all the time that could be spared from our several avocations. We present them as our personal contribution to the solution of a question of such great importance and difficulty, as to leave room for the researches of the whole world.

We have not thought it necessary to repeat what has been already said on the same subject in other works; these publications are of such recent date as to be present in the minds of all persons interested in this subject.

PART I.

In marine constructions very different kinds of materials are employed: wrought stone of large dimensions, the joints of which are carefully dressed; stones of smaller sizes, but still regularly worked; bricks, well burnt and of good quality; boulders and rubble masonry. These are bound together by cements or mortars of an hydraulic nature, that is to say, possessing the property of hardening under water.

The function of the mortar in marine construction increases in importance as the materials are less regular, and when, consequently, the proportion of mortar is more considerable. The difficulties to be overcome by the engineer are also the more serious, in proportion as the mortar is exposed more directly, and for a greater extent of surface, to the physical and chemical action of the sea-water.

In this first part of our work, we have not to treat of the various kinds of stone, brick, and rubble; but simply of the hydraulic limes, cements, and mortars, and also of the primary substances employed in their formation.

We shall first describe, in a very few words, the chemical conditions of the setting of mortars under water, and the principal phenomena in their application. These preliminary considerations are indispensable to the proper comprehension of the annexed series of analytical experiments. We shall finish the first part with an account of the results obtained from a large number of specimens, and with the investigation of these results.

§ 1. *Preliminary Considerations.*

The mortars employed in subaqueous constructions may be divided into two principal classes, viz.:—

1. Those composed of sand mixed with hydraulic lime, or with the natural or artificial cements; 2. Those obtained by the mixture of puzzuolanos with rich or with hydraulic limes, and, in almost all cases, with a certain proportion of sand.

In both cases, the sand is very frequently an inactive ingredient, chemically considered; it acts mechanically by imparting to the mortar a certain amount of resistance to a crushing effort, and in resisting the contraction which generally results during the setting. Sometimes, however, a sand containing clay or some of the silicates is employed, on which the free lime exerts a certain chemical influence, the effects of which may be very beneficial.

The mechanical and chemical actions of the sand will be mentioned and investigated in the second part of our notice. At present we will assume, in order to avoid any complication of the foregoing classification, that the sand is an inactive substance, that is to say, incapable of exercising any chemical action on the lime.

The scientific researches of M. Vicat, in accordance with all practical observations up to the present time, enable us to explain the setting of mortars and cements by the formation of hydrated compounds, the principal elements of which consist of silica and lime, or silica, alumina, and lime.

In the first of the two classes we have described, the combination of the lime, silica, and alumina is effected during the burning of the limestones, which are more or less argillaceous or siliceous. These compounds, formed by the dry process either wholly or partially completed, when placed in contact with water during their preparation and after their immersion, become hydrated, and a permanent solidification results from the formation of hydrated compounds, well defined, insoluble, and durable.

The reactions which accompany and follow this hydration are often sufficiently complex; but, in the more simple cases, the setting merely consists of the hydration of the compounds formed during the calcination of the limestones.

On the other hand, in the case of mortars made by the admixture of puzzuolanos with rich limes, the action on the puzzuolano can only take place by the humid process—the combinations of the lime with the silica or the alumina taking place simultaneously with the hydration.

These reactions are necessarily more complex when hydrated limes, which contain combinations of lime, silica, and alumina, formed by the dry process, are employed, and which would become hydrates on exposure to water. The durable setting of these mortars would then depend upon the parallelism of these two kinds of chemical action, one of which is confined to the *dry* portion of the process, while the other, commencing with the calcination of the limestone, is only completed by contact with the water.

We would at once observe that it is in the use of mortars composed of puzzuolano and hydraulic lime that the greatest difficulties have occurred, and that it is to the use of such mixtures that the larger proportion of cases in which success has not been attained may be attributed.

When the sand employed in the composition of mortar contains clay or any silicates liable to be acted upon by lime, the phenomena before described are still further complicated by the effect resulting from the excess of lime acting on the silica and alumina of the clay or of the silicates; the ultimate durability of the mortar may be impaired, or, on the contrary, increased, according to circumstances; and very often it is extremely difficult to foresee the result.

We shall revert again shortly to these various reactions, after describing the analytical methods we have adopted.

§ 2. *Analysis of Hydraulic Materials.*

We have to consider the methods of analysis to be employed—1. For the argillaceous and siliceous limestones; 2. For the products of calcination, the hydraulic limes, and natural or artificial cements; 3. For cements and mortars, after immersion in water for a longer or shorter period; and, 4. For the puzzuolanos.

In all these cases the order of the analytical operations is nearly the same, but the importance of certain proportions is not the same in all cases. Moreover, the results obtained should be presented in the table of analyses under a separate head for each description of material, in order that the discussion may be facilitated by the enumeration of those bodies which might act beneficially, and of those which would remain inert. It is, consequently, necessary to describe successively the system of analyses for the limestones, the limes and cements, the mortars, and the puzzuolanos, drawing especial attention to those operations from which the most important results may be expected.

1. *Analysis of the Argillaceous and Siliceous Limestones.*—The limestones are not used until after a calcination more or less protracted, and rarely after a second calcination. The analysis must, therefore, be conducted with a view to discover the proportions of those ingredients which would be likely to act on each other during the single or double calcination; and also the nature of the compounds which may be thereby formed.

It would appear more rational to make the analysis of the products of the calcination of the limestone; but there is, firstly, no relation between the chemical action created by the calcination of a small quantity of limestone in a crucible and that which takes place in the actual process; and, secondly, it appears to us absolutely necessary to examine the limestones themselves, in order to ascertain, from the general body of the results obtained, the precautions required to be taken in the calcination, so as to develop in the readiest manner their hydraulic properties.

Those compounds which possess the power of setting under water by hydration, contain lime and silica, or lime, silica, and alumina, the combination of which must be effected by calcination. It is indispensable that the silica and clay should be intimately mixed with the calcareous matter, and that the mixture should be homogeneous. It is self-evident, in fact, that, if the mixture be not intimate and homogeneous, the calcination can only produce a partial combination of the lime with the silica and the alumina; the compounds contained in the product of the calcination will not present the same composition in their various parts; and, consequently, will not be equally affected by the action which would be produced by the water.

When the limestone contains silica in the form of sand, in grains of appreciable size, the calcination would only cause the lime to act on the outer surface of those grains; and, consequently, on a proportion which would be smaller according as the grains were larger.

It becomes necessary, therefore, before commencing the analysis, properly so called, to go through a certain number of preliminary operations, the object of which would be, to ascertain the physical nature of the limestone; the homogeneity of the beds from which it is derived; the intimate character of the mixture of calcareous matter with fine sand and clay; and, lastly, the proportion of large quartzose sand.

We can only convince ourselves of the closeness of the mixture by outward examination, either with the naked eye, or with the assistance of a powerful lens. As regards its homogeneity, a large number of specimens should be procured, taken from different parts of the same bed; and the weight of each should be ascertained, as also the nature of that part of them which is insoluble in dilute nitric acid.

In cases where the mixture of the calcareous matter with the sand or clay

is evidently only to a slight extent intimate or homogeneous, it is not to be expected that calcination will yield a durable or valuable product; consequently, there is no object to be gained by continuing the analysis: but we must except those cases in which, from local circumstances, it would be possible to submit the limestone to a second calcination.

After the first calcination, the material should be rendered homogeneous, by grinding under edge stones; a second calcination completes the chemical action, which takes place under the dry process; and the ultimate product obtained would be a cement of good quality.

These first preliminary operations lead us to an important conclusion, as regards a considerable number of the calcareous beds, by showing the necessity for a second calcination. When this operation is possible, in an economical point of view, an analytical examination would show whether, from the relative proportions of sand, clay, and calcareous matter, the product of the two successive calcinations, after being reduced by grinding, would afford hydraulic results commensurate with the expense incurred.

With reference to those limestones containing quartzose sand, the size of the grains would greatly influence the extent to which it might be thought proper to prolong the calcination, or would even determine the necessity of a second operation. It is, therefore, of great importance to determine with sufficient accuracy the proportion and size of the grains.

For this purpose, a large quantity of limestone is coarsely pounded, passed through a hair sieve, and mixed up as closely as possible. We proceed in the next place, taking some given quantity, to wash it in a trough, or by repeatedly decanting it into a large earthenware vessel. We thus separate all the fine calcareous and sandy particles, and nearly the whole of the clay. The large grains of sand and limestone are collected at the head of the trough, or at the bottom of the vessel. They are treated with a dilute acid, which dissolves the calcareous particles, and leaves the quartzose sand, combined with a small proportion of fine sand or clay, retained by the calcareous particles. These are easily removed by fresh washing and decanting, and nothing then remains but the large quartzose sand, the weight of which is ascertained after drying. It is easy, at the same time, to observe the size of the grains, and, consequently, to estimate the difficulty to be met with in effecting the combination of the whole of the sand with the lime, by one or even two calcinations.

These preliminary operations are sufficient, in many cases, to indicate what may be expected from any limestone bed it may be proposed to work: they furnish us with information as to the proportion of fine sand and clay, and of the coarse sand; the homogeneity of the beds, and the intimate mixture of the ingredients. It is useful, however, to determine the precise hydraulic value of the limestone by proceeding to the complete analysis.

The first recommendation we have to offer has reference to the selection of the specimen: it ought to represent as exactly as possible the average nature of the deposit which it is proposed to work. The choice of these specimens is often a matter of some difficulty.

Limestone beds, in fact, are not generally very homogeneous; and we should be frequently led into error, if our analysis were confined to a single sample taken at hazard. We would cite for example the limestone of Theil, which may be considered to present a degree of homogeneity somewhat unusual: yet many of the beds exhibit, from one end to the other of the same quarry, variations of 4 or 5 per cent. in the proportion of fine sand and clay, considered with reference to the total weight of the specimen; which corresponds to variations of from 25 to 35 per cent. in the weight of clay and fine sand. So great a difference in the composition would exercise considerable influence on the quality of the resulting products.

Limestones and hydraulic cements usually contain quartzose sand in fine and coarse grains, clay, oxide of iron, lime, magnesia, carbonic acid, bituminous substances, water, iron pyrites, and even a small proportion of sulphate and phosphate of lime.

By exposure to strong heat in the crucible of a cupola furnace, we determine at once the water, the carbonic acid, and the bituminous matter. It is advisable to measure the carbonic acid by a separate operation; its amount, compared with the lime and the magnesia, shows whether these two bases are entirely in the state of carbonates, and thereby puts us on our guard as to the presence of a notable quantity of sulphate and phosphate of lime. The water and bituminous substances are taken together as the remainder, because there is nothing to be gained by estimating them separately.

The presence of a large proportion of organic matter precludes us, in most cases, from making our quantitative measurements on the limestone itself, and compels us to resort to the analysis of the product of the calcination in the crucible. In this case the results obtained have no longer any reference to the limestone under examination, but only to the particular product obtained in the laboratory; the calcination has caused the lime to act on the clay and the fine sand; the pyrites has given out sulphuric acid, and consequently also sulphate of lime. The inconvenience would not be so great, if it were possible to conduct the calcination in the crucible in such a manner as to produce nearly the same action as takes place during the ordinary calcination. But there is always a sensible difference in the chemical composition of the products of these analagous, but not exactly similar, processes; consequently, the results obtained have no relation either to the lime or to the hydraulic cement, which would be produced by calcination as usually performed.

The bituminous limestones frequently contain iron pyrites in intimate combination, and produce limes or cements which contain a considerable proportion of sulphate of lime. This compound is certainly detrimental to mortar, first, because it is soluble in water; secondly and especially, because its solidification is not contemporaneous with the hydration of the compounds of the lime with the silica and the alumina. This would give rise to a molecular action, which might be injurious if the proportion of sulphate of lime were very considerable.

The limits which should determine the proportion of this compound in hydraulic materials have not yet been defined; and, consequently, we cannot distinctly affirm that a limestone which contains pyrites cannot yield products which would be successful in application. Nevertheless, we should always consider their presence as unfavourable, and endeavour to ascertain the proportion of sulphate of lime which they might yield.

The non-bituminous limestones do not contain pyrites in regular combination, but they contain occasionally nodules of that substance. It is, consequently, an easy matter to separate them in breaking up the stone, and there is no necessity for taking any account of them in the analysis.

There is, therefore, a great difference in the treatment to be adopted for those lime stones which contain organic substances, and for those which do not. We will consider them separately.

Limestones not containing Organic Substances.—We shall range under this head all those limestones which contain so small a proportion of organic matters that their presence has no appreciable effect on the analysis, and in which we can assure ourselves, by microscopic observation, of the absence of iron pyrites in combination.

We begin by assuring ourselves that the limestone under consideration contains no sulphate of lime, by steeping in water, for a considerable time, a certain weight of the sample, well pounded. In case of the presence of the sulphate of lime, both the sulphuric acid and the lime can be easily measured, by dividing the liquor into two parts. The analysis would be then continued on the part insoluble in water.

Many methods have been proposed for this analysis, and nearly all of them would give correct results. We would advise that one of them should be selected, and the same always employed for all limestones under examination. The practice acquired in the application will render the operations more rapid, and diminish the sources of error; besides which, and above all, the results obtained from the several specimens will admit of closer comparison.

We have adopted the following series of operation:—

The limestone is treated with nitric acid, the liquid evaporated to dryness, and the residue treated with diluted nitric acid.

The solution contains lime, magnesia, oxide of iron, and also alumina, in the case of the argillaceous limestones; these bases are separated, and determined in the ordinary manner, which, we suppose, need not be here detailed.

The insoluble portion should be carefully analyzed. It contains quartzose sand, clay untouched by the acid, and silica derived from that portion of the clay which is dissolved by it. The silica is got rid of by an immersion for 24 hours in a weak solution of potash, and its proportion ascertained.

This examination affords some useful information on the chemical condition of the clay, and might serve, to a certain extent, in estimating the facility, be it more or less, with which the lime would act on the clay during the process of calcination. In entering this result in the table of the analyses, we must not lose sight of the fact that it merely represents a simple indication, and that it cannot lead to any precise conclusion.

The second residue, consisting of the undissolved clay and sand, is treated by fusion with carbonate of soda. The silica and alumina are separated and measured.

From the weight of the alumina, as found in the two parts of the analysis, we calculate the proportion of clay, assuming that it contains two parts of silica to one of alumina. The remainder will give the proportion of sand. On the other hand, the preliminary operations have indicated the proportion of large quartzose sand, and from this we deduce the quantity of fine sand.

In order to interpret the results obtained, we may assume that a calcination continued for a long period would produce a complete action of the lime and the magnesia on the fine sand and on the clay, provided that the combination of these substances with the carbonates were sufficiently intimate: but it is certain that the large sand would only be partially affected, and so much the less as the grains were larger. It becomes necessary, therefore, to consider only the fine sand and the clay as brought into activity by a single calcination. The coarse sand would, indeed, produce a certain quantity of silicates, and therefore its presence should not be neglected; but it is impossible to predict in what proportion it would be acted on.

It has been proposed to class the limestones, with reference to the hydraulicity of the products obtained by calcination, according to the proportions of fine sand and clay which they contain. This classification is certainly defective; for the homogeneous character of the mixture of sand, clay, and carbonate of lime, its closeness, and the size of the grains of quartz, must affect the quality of the lime at least as much as their relative proportions taken at their absolute value. Besides, the sand does not enter into the same combinations as the clay; and experience has shown that the silicate of lime can of itself produce valuable results, the mortar produced from which resists the action of sea-water as effectually as those containing combinations of lime, silica, and alumina. But, in the present state of the question, it is not possible as yet to determine what proportion of fine sand corresponds with that of the clay in producing results of any given quality.

Besides all this, the precautions observed in their application in practice exercise likewise a considerable influence on the ultimate results.

For all these reasons we are of opinion that it is impossible to decide, *à priori*, from the analysis of a limestone, whether the product of its calcination will be a hydraulic lime or a cement. Operations on a large scale can alone exhibit the hydraulic nature of the product of the calcination under particular conditions. We can only presume that a limestone, containing a close and homogeneous mixture of from 12 to 18 per cent. of fine sand and clay, will yield a good hydraulic lime, and that one which contains from 18 to 25 per cent. of clay will produce a cement.

In the analysis above described we have supposed that the limestone contained no considerable proportion of phosphate of lime. This is, indeed, most frequently the case; but it is well to be assured of the absence of this substance, as it would considerably modify the details of the analysis. A certain weight of the limestone is treated with diluted nitric acid, and into the liquor, when clear, is poured a small quantity of molybdate of ammonia: this agent indicates the presence of the phosphoric acid by a yellow tinge, or a granular yellowish precipitate, which is slowly formed. The simple discoloration indicates traces only of the phosphoric acid; a perceptible precipitate, by announcing the presence of an appreciable proportion of it, would induce the necessity of modifying the details of the analysis.

We shall not stop to describe the operations to be resorted to in order to get rid of the phosphoric acid before proceeding to determine the bases—first, because those operations are well known; and, secondly, the presence of the phosphate of lime is a very rare case—we might almost say, exceptional.

Limestones containing Organic Substances.—Those limestones which are impregnated with organic matter contain most frequently pyrites in combination, which it is nearly always impossible to detect under the lens. The most injurious effect they produce is the production of sulphate of lime during the calcination; and, on this account, it becomes necessary to ascertain the quantity of sulphate of lime which exists after roasting the stone in a crucible, instead of estimating that already formed in the limestone itself, as it is certain that calcination in the crucible will produce more sulphate of lime than the actual calcination, and, therefore, we obtain a higher limit for the proportion of that salt which might afterwards be found in the lime or the cement.

The burning in the crucible should be conducted very slowly, at a temperature a little above dull red; it should terminate a little below that degree, so that the carbonic acid from the furnace, penetrating into the crucible, may saturate the greater part of the lime which had been brought to the caustic state during the earlier stages of the operation.

After cooling, the mass is immersed in a large quantity of water, and left to soak for some time, in order to dissolve the sulphate of lime. From the liquor the sulphuric acid alone is determined, and its weight enables us to calculate the sulphate of lime. This result might be arrived at more rapidly by subjecting the burnt stone to ebullition with carbonate of soda; but it is difficult to determine correctly the sulphuric acid in the presence of a large excess of alkali; we therefore give the preference to the method by immersion, notwithstanding the long period necessarily occupied by the soaking.

We are of opinion that it is dangerous to employ in marine constructions limes or cements containing 5 or 6 per cent., or upwards, of sulphate of lime.

We enunciate this opinion with some caution, as the experiments which have been made on the influence of sulphate of lime on mortar are not sufficiently defined to enable us to establish an exact limit.

As the analysis cannot be made on the limestone itself, we must of necessity proceed to the investigation of the burnt stone. It is immersed in water in order to dissolve the sulphate of lime and also the lime which exists in the caustic form. The lime is measured in the ordinary manner.

The insoluble portion is treated with nitric acid, and the operations are conducted in the same manner as for non-bituminous limestones. We must observe, that there is now no reason for determining the silica, which is reduced to the gelatinous form by the action of the nitric acid, because the burning has given rise to a partial action of the lime on the quartz and the clay. This proportion of silica has no definite relation to that which the clay itself would yield, nor to that which would be found in the lime after calcination.

2. *Analysis of Hydraulic Limes and Cements.*—Great importance should be attached to the analysis of the limes and cements obtained from the calcination of argillaceous or siliceous limestones, because we may obtain from them tolerably accurate information as to the chemical nature of the substance itself, as it is intended to be employed.

We should repeat here what has been before said on the subject of the precautions to be observed in the selection of the sample. Limes and cements are not more homogeneous than the limestones from which they are derived, and the results obtained can only be of use in so far as they apply to the actual material to be employed.

A fair average specimen having been selected, it should be preserved until the time of its analysis in such a manner as to prevent the absorption of water, and of the carbonic acid of the atmosphere—a condition not easily attained, on account of the affinity for water and carbonic acid possessed by the free lime contained in the substances under consideration. Samples of hydraulic lime, in pieces, may be preserved for several months in powdered lime, the whole being enclosed in well-secured boxes. Cements in powder remain in good condition in glass-stoppered bottles.

The analysis comprises the following operations:—

1. By means of a strong calcination we determine the amount of the water and of the carbonic acid: this last is measured by a separate process, and the water taken as the remainder.

2. By steeping for a long period, at a moderate temperature, a certain weight of the material in a large quantity of water, we dissolve the free lime and the sulphate of lime; the liquid is divided into two parts; in one the lime is measured, and in the other the sulphuric acid. We can never be certain of dissolving the whole of the lime presented in the caustic form, because it is retained with considerable adhesive force by the clay and the siliceous combinations; and, moreover, it is almost certain that a large body of water would carry off a certain quantity of lime combined with alumina, and perhaps also a portion of that in combination with the silica. Under these circumstances, the figure given by the analysis for the free lime soluble in water must not be considered as representing accurately the caustic lime, but be taken merely as an approximation.

3. In most cases, the sulphuric acid is present in so small a quantity, that there is no necessity to take account of it in determining the bases and the silica. Under these circumstances, the analysis may be made on the material itself. When the contrary happens, we must operate on that portion which is insoluble in water.

The material is treated with nitric acid evaporated to dryness, and treated a second time with the same acid. In the liquid we measure the bases, lime, magnesia, alumina, and oxide of iron; in the insoluble portion we determine the silica, reduced to the gelatinous state by the action of the acid, by dissolving it in a weak solution of potash.

The second residue is composed of clay and sand, which may be considered as remaining inactive during the setting under water. There is, consequently, no need of analyzing it; it would be sufficient to estimate the proportions of the clay and the sand by examination under a lens. We need scarcely remark, that in limes and cements of good quality, the proportion of this residue ought to be extremely small. In this case, the quantities obtained for the silica and the alumina may be considered as corresponding with sufficient accuracy to the combinations of the silica with the lime, or those of the silica, the alumina, and the lime. In the other case, when the proportion of the sand and clay is considerable, there is more or less uncertainty as regards the alumina and the silica soluble in nitric acid and in the alkaline solution. These quantities comprise, under one head, the silica and alumina in combination with the lime, and that produced from the clay which had been partially dissolved by the nitric acid and by the solution of potash—it is impossible to determine in what proportion.

A considerable residue of fine sand and clay, from 10 to 12 per cent., of the prepared material, for instance, shows that the limestone was not homogeneous, or that the calcination was imperfectly effected; or, again, that the limestone was too highly charged with clay and sand. In this latter case, practical experience assures us that the cement so manufactured would be of inferior quality.

The different cases are easily distinguished in the course of the analysis by the proportions of caustic lime and of carbonate of lime, very large in the former, and very inconsiderable in the latter.

The foregoing remarks are not without importance, as they lead to the conclusion that, as regards materials of good quality, the analysis gives a sufficiently correct approximation to the actual quantity of silica and alumina which may enter into active combination.

The lime which exists in combination with the silica and the alumina is calculated by deducting from the total weight of lime that portion which is soluble in water, and also that in combination with the carbonic acid. The proportion of magnesia is, in most cases, small, and it may be considered as in combination with the silica or alumina. The oxide of iron, which is generally present in considerable quantity, is probably inactive in hydraulic limes; but it may be combined with the silica, the alumina, and the lime, in the vitrified portions of cements; and may, consequently, require careful investigation in the case of each particular specimen. We shall give an example further on, when detailing the analyses of the Portland cements.

In noting the precautions observed in the selection and preservation of the specimen, the following particulars should be entered in the table of the analysis:—

1. The water probably absorbed after calcination.
2. The carbonic acid which might result from an imperfect calcination, or from the subsequent action of the atmosphere.
3. The lime in the form of sulphate.
4. The lime in combination with carbonic acid.
5. The free lime, soluble in water.
6. The lime and magnesia which may be in combination with silica alone, or with silica and alumina.
7. The alumina and silica in combination with the lime and magnesia.
8. The oxide of iron, with respect to which we should observe whether, from the appearance of the specimen, it may be considered as inert matter, or as in combination with silica and the bases.
9. The inactive clay and sand, an excessive proportion of which indicates the inferior quality of the material under consideration.

In a separate table are collected the silica, alumina, lime, and magnesia, which may be regarded as active in the setting; and the proportion of oxygen contained in all these bodies is calculated. These results, as we shall shortly see, are of very great importance.

The specimen under consideration may be classed among the hydraulic limes, or the cements, according as the proportion of free lime is large or small; but this classification need not be very exact, because the mode of application exercises great influence on the rapidity of the setting under water, and also because, under certain circumstances, hydraulic limes may act in a manner very similar to the cements.

We shall again recur more in detail to this subject in the second part of our work.

3. *Analysis of Cements and Mortars after Immersion for a certain Time.*—The analysis of the morters and cements employed in marine constructions can only give useful results when it is possible to collect very complete information; and, moreover, when the selection of the specimens has been made with the requisite care. It is necessary to be well informed of the composition of the original materials employed, the conditions under which the work was executed, the more or less perfect state of preservation, and the external conditions which may have assisted them, such as the coating of marine shells, sea-weed, or simply of mud. It would be likewise necessary to obtain a series of specimens corresponding with the various conditions of the materials, and taken at different distances from the surface. This last condition can be very rarely attained, inasmuch as it would be necessary to demolish the construction, in part at least.

In many cases, it is only possible to procure fragments from the surface; and, under these circumstances, the information afforded by the analysis may be very useful, but not sufficient for the complete study of the chemical actions which determine the setting, and of those which result in a more or less rapid decomposition.

It is necessary to separate as completely as possible, by mechanical means, from the specimens under examination, all inactive substances, broken fragments of stone, rubbish, and coarse sand, in order to ascertain with more certainty the chemical combination of the hydrosilicates, which alone are useful in resisting the actions of the sea. There always remains a certain proportion of fine sand, often considerable in quantity, which it is impossible to separate mechanically: this sand sometimes contains carbonate of lime, whose presence prevents us from distinguishing the influence of the sea-water in saturating the caustic lime and destroying its solubility in water. This influence might be exercised during the preparation of the materials, or after immersion: in both cases, and particularly the latter, the carbonate of lime, being formed in greater quantity towards the surface, would to a certain degree act as a preserving agent.

The density or porosity of the materials ought to be attentively considered. These qualities or defects depend on the chemical composition of the hydraulic lime or cement employed; on the proportion of sand which resists contraction at the moment of setting; on the mode in which the mortar is prepared; and on the chemical action produced by the sea-water and the salts therein contained.

Without entering minutely into the discussion of these various conditions, we may at present say a few words respecting them, which may give an idea of the importance we attach to the external examination of mortars, which ought in every case to precede the analysis.

Experience shows that the hydrosilicates, the formation of which controls the setting, contract during their solidification, within limits which vary greatly with their chemical composition. The hydrosilicate of lime appears to possess less power of contraction than that which contains alumina. The effect produced in both cases, in the absence of sand and other inert matter, is analogous to what might be obtained by squeezing with more or less force a sponge dipped in water with solid matters in suspension. This effect is very distinctly observed in the experimental tubs in which the mortars are immersed, after being moulded in the form of bricks. Their volume diminishes at the moment of setting, and a portion of the lime is expelled, and forms a milky cloud around the bricks.

In Portland cement, containing silica, alumina, and lime, the contraction is great. In the case of the lime of Theil, which contains only an inconsiderable proportion of alumina, it is very slight. In a practical sense, this contraction may be either very injurious or very useful. It is injurious, in so far as the mortar presents cavities of considerable size, and does not entirely fill up the space between the materials which it is designed to connect, or rather requires very minute precaution in its application, and, as a consequence, both skilful workmen and active superintendence. It is useful, because mortars of great density do not allow the percolation of the sea-water; an inestimable advantage in a great number of constructions in harbours.

In a chemical point of view, the greater contraction presents likewise its advantages and disadvantages. The mortar being impermeable, the decomposing action of the water and the salts therein contained is little or, in fact, nothing upon the inner portion of the work.

On the other hand, if the mortar be not homogeneous, if it contain different hydrosilicates, the solidification of which does not take place at one time, the setting of the slower portion might destroy the solidity already acquired by the more rapid one. This source of disintegration can only be avoided by great care in working.

Sand is almost always combined in large quantities with hydraulic limes and cements. Leaving out of account the chemical action of the clay it may contain, and which acts like puzzuolano on the free lime, it may be considered useful in two respects: it constitutes what may be termed the bony skeleton of the mortar, and imparts to it its rigidity; and it offers an almost effectual resistance to the contraction peculiar to the hydrosilicates, and consequently renders the working of such mortars more easy. The sand has, however, the great disadvantage of causing porosity, and substituting an immense number of small spaces for the larger cavities produced by the contraction of the hydrosilicates at the moment of setting. This porosity, which is moreover frequently increased by the neglect of the necessary precautions in application, renders the mortar permeable, and allows the water and its contained salts to act with too great rapidity throughout the mass of the work. The use of sand in large quantities is consequently a difficult question, and we do not think that up to this time sufficient importance has been attached to the study of the effects—first mechanical, and afterwards chemical—to which it may give rise.

The mode of preparation of the materials which enter into the composition of mortar, and of the mortar itself, produces considerable effect on its chemical composition and its physical condition. We shall show this in the discussion of the results obtained from the analysis of a certain number of specimens, especially in the second portion of our notice, and will here only

give one example:—Portland cement, gauged in the ordinary manner, without the addition of sand, produces a mortar more or less porous after setting; the same material, diluted to the consistence of a thin clear paste, and immersed in still water, sets, after a certain interval, in a compact mass, extremely hard, and resembling the most durable stone.

Moreover, the chemical actions of the sea-water are extremely complex, and analysis is frequently powerless to distinguish them, especially when it is confined to an isolated sample. It is important, therefore, to endeavour to ascertain, from external examination, on the spot, the amount of disintegration, of augmentation in volume, and of the porosity which may be attributed to a solution of the ingredients; and to compare the appearance of the decomposed portions with that of such parts of the construction as remain uninjured. Specimens should then be selected for analysis, which exhibit the different actions of the sea-water; the appearance presented by each indicates, in most cases, the cause of the decay; and, consequently, greatly facilitates the chemical investigations.

The gases contained in sea-water vary greatly with local circumstances. In several ports, particularly at Marseilles, carbonic acid and sulphuretted hydrogen are found in much greater proportion than in the waters of the British Channel and of the Ocean. These gases would act on the free lime contained in the mortar; the carbonic acid would produce carbonate of lime; but it is impossible to foretell what might be the action of the sulphuretted hydrogen; it might produce either oxy-sulphuret of calcium, insoluble in water, or sulphate of lime, soluble and crystallizable. The chemical operations necessary for determining the proportion and the nature of the gases contained in sea-water, and their action on mortar, ought to be conducted on the spot, and not on samples carried about and exposed for a longer or less period to the action of the atmosphere. No investigations have yet been made on this subject, and we must here confine ourselves to mentioning their importance.

The course of the analysis is nearly the same as for hydraulic limes, but is rendered rather more complex by the determination of the alkaline salts with which mortars are always impregnated. Their proportions are ascertained at the same time with those of the free lime and of the sulphate of lime, in a solution made by treating the mortar with a large quantity of water. The hygrometric water must also be taken into account; not because it possesses any importance in itself, but simply because it will have to be deducted from the total quantity, in order to ascertain the water in combination.

In the table of the analysis should be particularized—

1. The hygrometric water, and the water in combination.
2. The carbonic and sulphuric acids.
3. The lime soluble in water, and in the alkaline salts.
4. The oxide of iron, alumina, lime, and magnesia.
5. The silica, which might first be rendered gelatinous by nitric acid, and afterwards dissolved by potash.
6. The clay and sand which remain unaffected by liquid processes. In a second portion of the table should be entered the result of the calculation of the lime in combination with the carbonic and sulphuric acids; and from this we may deduce with sufficient accuracy the proportion of lime in combination with the silica and alumina. On one side is noted the silica, alumina, lime, magnesia, and water; which may be considered, from the results of the analysis, as in a state of combination.

Lastly, we should detail, in the latter part of the table, the quantities of oxygen contained in the silica, alumina, lime, magnesia, and water combined.

After the analysis, we should proceed to the examination of the results, and endeavour to deduce from them the approximate chemical composition of the permanent hydrates; we should likewise compare this composition with that of the materials employed, and thence determine the principal reactions which would take place during the preparation, and after the immersion of the mortar.

We shall give farther on a few examples of the examination of these results for a certain number of mortars; but we must now describe the causes of error or inexactitude presented by the various computations.

Computation of the Water.—Water may be found in the mortars under many forms, either hygrometric, or in combination with the caustic lime, or the sulphate of lime, or with the silicates which take an active part in the setting, or with the inactive clay, if the mortar contain any. The hygrometric water is generally measured by a prolonged desiccation, at a temperature of from 100° to 110° centigrade (212° to 248° Fahr.). It is to be apprehended that the hydrosilicates would at this heat lose a part of their water of combination; and it would therefore be preferable to determine the hygrometric water by desiccation under the receiver of the air pump.

The water of combination is determined by calcination; from the total loss we deduct the hygrometric water and the carbonic acid, which is measured separately.

We may thus obtain a sufficiently correct approximation to the total amount of the water of combination. The chief difficulty and source of uncertainty is found in the computation of the proportion of water in combination with other compounds than the hydrosilicates; and for most of these it is impossible to tell what quantity of water they may lose; and we would especially mention peroxide of iron and the clay. These errors have all a distinct bearing on the water of combination of the hydrosilicates, inasmuch as it is determined by remainder. Moreover, when the examination of the results indicates the presence of many and various hydrated combinations of silica, alumina, and lime, it is impossible to distinguish, at least in the majority of instances, the proportion of water belonging to each of them.

Computation of the Sulphate of Lime, of the Lime soluble in Water, and of the Alkaline Salts.—These substances are measured in a solution made by treating the mortar with water; great accuracy is attainable for the sulphuric acid, and from its weight is calculated the sulphate of lime, which is, in fact, the same thing, as regarding the sulphuric acid as existing entirely in the form of sulphate of lime. This hypothesis is probably, but not absolutely, correct; but the error which would result from its inaccuracy would be of but little importance in the greater number of analyses, for in all the specimens which we have examined, we have found a very small quantity of sulphuric acid.

The lime in solution may be measured with tolerable correctness; by deducting from the total weight the lime in combination with the sulphuric acid, we ascertain from the remainder the free lime soluble in water.

We have already said that this quantity is very uncertain, because water, when used in large quantities, may carry off a certain quantity of lime from the alumina and hydrosilicates; and, on the other hand, because the adhesive force which binds to the clay, and probably to the hydrosilicates, such lime as is not in combination is so great that we can never be certain of having dissolved in the water the whole of the lime not in combination.

In addition to this, the atmospheric air penetrates into the vessel in the course of the prolonged saturation, and its carbonic acid renders insoluble a portion of the lime previously in solution.

The alkaline salts contained in a very diluted solution, but always in small quantity, cannot be exactly computed, even in the absence of magnesia soluble in water. It is certainly more correct to calculate them from the difference in weight of the mortar, dried to the same degree before and after its treatment with water. The computation of these salts is always attended with uncertainty, and we may add, that generally it has no particular effect on the determination of the useful portions of the mortar.

(*To be continued.*)

Death of Mr. E. Billows, Engineer of the Oriental Gas Company.—The last overland mail brings intelligence of the premature death of this gentleman, which took place in Calcutta, on the 3rd ult., from an attack of cholera, under which he sunk in a few hours. Mr. Billows was well known, and greatly respected, as the manager for several years of the Dorchester Gas-Works; and, relying upon his temperate and abstemious habits for resisting the evil effects of a climate to which all his predecessors had fallen victims, he was induced to accept the tempting offers of the Oriental Gas Company, in the hope that a few years' service would enable him to provide for his numerous family. Providence has decreed otherwise; and his widow, with eight children, are thereby thrown on their own resources, and the consideration of those in whose service he has laid down his life. This distressing event has caused severe comments to be made on the policy of the directors of the Oriental Gas Company in sending victim after victim to a premature grave; and the opinion is gaining ground, that its continuance amounts almost to criminality. Surely acclimated persons might be sent to England, and sufficiently instructed in their duties to carry on the company's operations in India, without resort to the revolting temptation to moral suicide which the present system encourages.

The "Four Shilling Mixed."—We regret to hear of numerous com-

Price Current.

CASTINGS, per Ton.

Average Weight of Cast-Iron Gas-Pipes, per Yard.

1¼ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow	Newcastle.	Wales.	Yorkshire, Derbyshire, and Staffordshire.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pig Iron, No. 1	4 10 0	3 13 0	3 13 0	4 0 0	4 10 0
1¼ and 2 inches Socket Pipes	8 0 0	7 5 0	7 10 0	7 15 0	7 10 0
2½ and 3 " " "	7 10 0	7 0 0	7 5 0	7 10 0	7 5 0
4 and 5 " " "	7 10 0	6 15 0	7 0 0	7 5 0	7 0 0
6 in. & upwards " "	7 5 0	6 10 0	6 10 0	7 0 0	6 10 0
Retorts, 1st fusion, hot blast	7 0 0	...	7 0 0	7 5 0	7 0 0
" 2nd " cold "	8 0 0	...	7 5 0	7 10 0	7 5 0
Tank Plates, ¼ thick and above	7 10 0	6 15 0	7 0 0	7 5 0	7 0 0

COALS.

NEWCASTLE.	s. d.		SCOTCH CANNEL.	per ton.
Unscreened.			Boghead, at Leith	32s. 0d.
Whitwell Primrose, Burnhope	6 6	per ton	Kirkness, beat	23 0
Pelton and Medomsley	7 0	"	Capeldrae, 1st quality	20 0
Pelaw	7 3	"	" 2nd "	12 6
Eighton Moor, New Pelton, Peareth, South Pelaw, Washington Hutton, & South Peareth	7 6	"	Lesmahago, at Glasgow	25 0
			" " Leith	27 6
			Arniston	22 0
			Wemyss	20 0
			Knightswood	18 0
Ramsay's Newcastle Cannel	15 0	"	Pirnie (late Methill)	15 0

SUNDRIES.

Best Newcastle fire-bricks	60s. per 1000	Welch bar iron, in London	£8. 10s. per ton.
" " " clay	12s. per ton.	Foreign spelter	£30. 10s. "
Cliff's fire-bricks at Wortley,	57s. 6d. p. 1000	English block tin	£140 "
Tough cake copper	£117 per ton.	Banca " "	£145 "
English pig lead	£24. 10s. "	Tarred rope yarn	26s. per cwt.

WROUGHT-IRON TUBING, subject to 40 per cent. Discount.

	2 inches.	1¼ inch.	1¼ inch.	1 inch.	¾ inch.	½ inch.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent welded tubes, from 2 to 12 feet, per foot	1 8	1 0	0 10	0 7	0 5	0 4½
" " 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting pieces, or long screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, springs, and elbows—wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron cocks	17 6	9 6	7 6	4 6	3 3	2 6
" with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing sockets, caps, plugs, and nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain Sockets	1 0	0 8	0 7	0 5	0 4	0 3
Syphons, 2 quart	15 0	14 0	13 6	13 0	12 0	

FREIGHTS, per Ton.

Coastwise—Newcastle.		*Foreign.*	
Chatham & Roches-	6s. 0d	Boulogne	8s. 0d
Cork [ter	10 3	Barcelona	26 0
Dover	7 0	Bordeaux	16 0
Dublin	10 9	Cadiz	19 0
Exeter Quay	9 0	Calais	8 0
Folkestone	6 6	Dieppe	8 9
Hastings	7 6	Genoa	27 0
London [mouth	6 0	Hamburg	8 9
Lowestoft & Yar-	4 6	Havre	9 9
Lynn	5 0	Leghorn	24 0
Portsmouth	8 0	Lisbon	19 0
Plymouth	8 9	Rotterdam	8 3
Whitstable	6 3	Stettin	13 0
Weymouth	8 0	Trieste & Venice	30 0

plaints as to the supply of gas by the Great Central, and that the directors have already lost customers in consequence. During nearly the whole of last week the illuminating power has not exceeded 8 candles, owing no doubt to the neglect to use cannel coal, combined with working at a large vacuum, by which a quantity of air has been mixed with the gas. We also learn that the greatest confusion prevails at the works, and that the directors are at length satisfied that it would have been better for the company had they inclined a more attentive ear to the many warnings given them by Mr. Croll in regard to the necessity of making early preparation for the supply of the coming winter. Mr. Croll earnestly impressed this necessity upon the board by numerous communications, written and verbal, but without effect.—*Gas and Water Times.*

THE GAS SUPPLY AT SWANSEA.—Mr. Andrews, the active and able manager of the gas-works, is now daily engaged in ripping up our streets for the purpose of affixing larger gas-pipes. Some of the old pipes were so corroded that it would have been almost impossible to have passed a lead pencil through them. Many improvements are being effected at the company's works, and we may expect that, during the ensuing winter months, we shall be well supplied with that great desideratum—*cheap and pure gas. The Cambrian.*

Advertisements.

LIVESEY FIRE-CLAY WORKS,

NEAR BLACKBURN, LANCASHIRE.

ORLANDO BROTHERS,

MANUFACTURER OF PATENT CLAY RETORTS,

AND EVERY DESCRIPTION OF

TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.

FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

TO GAS COMPANIES, GAS PROPRIETORS, AND GAS ENGINEERS.

JOHN VICKARY

begs to call the attention of the above to his improved METALLIC CASE GAS-METER, an improvement which has met with entire approbation from the various Gas Companies and Engineers to whom he has introduced it, and acknowledged to be the greatest improvement that has been made since the year 1833; at which period a metal was introduced for the construction of the Drum, Syphon, and Float, capable of resisting any impurities arising from either gas or water, which has been found to answer every expectation; as, in repair, Drums of the above date are found in perfect and good condition, when the Outer Case, Valve-box, Inlet-pipe, &c., are quite destroyed and entirely past repair.

J. V. has introduced a coating or lining of the above metal in the Outer Case, Valve-box, Inlet-pipe, &c., thereby rendering the whole as durable as the Drum, as not a particle of tin plate is exposed to the action of either water or gas; and preventing the possibility of gas passing above the water line through the front into the body of the Case to the outlet unregistered, which frequently occurs. When the Meter has been in use for any length of time it is generally found that rust or decay takes place *above* rather than under the water line, which is only discovered when they need repair. Also the Inlet-pipe and Valve-box are generally found quite decayed, which cannot happen in the above improvement.

J. V. feels confident that the above will be found a most desirable and perfect instrument, as it contains all other improvements of utility that have been introduced up to the present time.

The most strict attention is given to the workmanship as well as the registration of every Meter, to render them perfectly accurate.

Station Meters, Governors, &c., made on the shortest notice, as well as Gas Cooking Apparatus of every description, Gas Baths, &c.

Meters sent at the lowest London prices.

Carriage paid to any part of England.

WEST OF ENGLAND GAS METER AND GENERAL GAS APPARATUS MANUFACTORY, 84, FORE STREET, EXETER.

BOYLE'S PATENT SILVERED

GLASS REFLECTORS

are the most durable, and are cheaper and better than any other.

HULETT and CO., Sole Agents,

Patentees of the only really good

MERCURIAL GAS REGULATOR,

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WANTED, by the Keighley Local BOARD OF HEALTH, a good Second-hand STATION METER, to pass 10,000 cubic feet per hour.

Applications, stating price and other particulars, to be addressed to RISHWORTH ASQUITH, Gas Office, KEIGHLEY.

July 28, 1857.

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Thirty years RETORT SETTER to some of the leading London and Provincial Gas Companies, to whom he can refer, begs leave to draw attention to his economical mode of Setting Clay or Iron Retorts, &c.

F. S. will engage to provide all materials and labour, or labour only.

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JAMES LYNE HANCOCK'S Vulcanized Indiarubber Hose Pipes and Tubing. Manufactory (and Warehouse), Goswell-mews, Goswell-road, London.

Gas Companies, Engineers, Gas Fitters, and the Trade generally, are respectfully informed this Tubing is now manufactured to any size, from ¼ inch bore and upwards, in 100-feet lengths, and perfectly cylindrical, either with or without a spiral wire inside.

VULCANIZED GLAZED FLEXIBLE TUBING, from ¼ inch up to 1 inch diameter, made in 24-feet lengths; or, covered with silk or worsted, up to 100 feet.

VULCANIZED HOSE, for FIRE ENGINES, BREWERS' USE, and for standing great pressures, (Rubber and Cloth combined), made to any length or size to fit the necessary screws, &c.

VULCANIZED INDIARUBBER AIR-TIGHT BAGS, made any size, for Gas Mains, with flexible tubes attached, and fitted with stopcocks complete.

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A FULL REPORT of the Recent Prosecution at the Central Criminal Court for STEALING GAS from the IMPERIAL GAS COMPANY. Reprinted for extended circulation from the JOURNAL OF GAS LIGHTING.

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The Bank of England is fitted entirely with these Valves, from the smallest branch to the largest main pipe.

The following, among numerous testimonials, will be found very satisfactory:—

"The British Gaslight Company's Office, No. 105, Broad-street, Ratcliff, London, June 10, 1846.

"Gentlemen,—In reply to your inquiry, I have to state that 'Carter's Patent Gas Valve' has been used by this company and by the fitters of the district extensively for seven years past. It was adopted to obviate the inconvenience of setting fast, so prevalent with the conical metal plug-cocks, and has been found to answer the purpose intended.

"I have recommended its use in several provincial towns with which I am professionally connected, and have not received any complaint of its having failed in any respect of performing satisfactorily all that is required of it.—I am, gentlemen, yours respectfully,

"GEDDIE PEARSE.

"Messrs. Lambert and Son, Lambeth."

CAST-IRON Retorts, Socket Pipes, with Syphons and all requisite Connections, Lamp Columns, Wrought Iron Tubing, Valves, Street Lamps, Sight Holes, Furnace Doors, Ash Pans, Charging and Coke Shovels, Iron Pails and Coke Barrows, Cross Bars, Fire Pots, Pumps, Iron Borings.

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Mr. KERBY is prepared to design Apparatus for the Manufacture of Sulphate, Muriate, or Carbonate of Ammonia.

He would call the attention of Gas Managers to the importance of converting their comparatively unsaleable "Ammoniacal Liquor" into an article easily disposed of.

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GAS BATHS, GAS COOKING and HEATING STOVES, for all classes. The British Polyteehnic Gas-fire, &c. Conservatories and Buildings heated by gas, and perfect ventilation secured.

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Gas-works erected for private houses, where no gas company exists.

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(Successors to the late Samuel Crosley),

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Beg to announce that, in addition to the manufacture of GAS-METERS, they continue the manufacture of METERS for MEASURING WATER, SPIRITS, &c., commenced, under Patent in 1849, by the late Mr. William Parkinson.

These Meters are as simple and durable as the Gas-Meter, and as correct as that instrument in the registration of the fluids passing through them.

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Manufacturers of all sizes of Cast-Iron Main Pipes, by an improved Patent. General Ironfounders, Gas Engineers, and Wrought-Iron Tube Makers.

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Manufactory for every description of Casting and Machinery for Gas Works and Water Works.

Warehouse in London for Cast-iron Pipes and Connections of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

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improvements he has made in the Wet Meter, and which he has secured by her Majesty's Royal Letters Patent, the accuracy of their registry is rendered certain by the introduction of the adjusting slide and hydraulic, whereby a Perfect Water Level is readily obtained, and the Hydraulic precludes the possibility of abstracting water from the meter by increased pressure or otherwise, thus surmounting the great desideratum of the Wet Meter. In his Patent Equitable Gas Meter neatness and strength are combined, the backs and fronts of the case being stamped by powerful machinery out of thick plate iron (tinned or galvanized); and the internal construction is of the best metal, which will resist the action of any impurity in the gas.

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W. and G. would respectfully call the attention of Gas Engineers and Managers to their Station-meters, having made and erected the largest in use at the present time, two of which may be seen at the Stockport and Liverpool Gas Works, on application to the respective Engineers.

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Experimental and Station Meters of any size made to order on the shortest notice.—Governors, Pressure Registers, Gas-cooking Stoves, and every description of Gas Apparatus.

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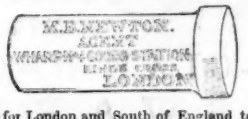

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Price, from 18s. 6d. each, and upwards.

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GAS BATHS, HEATING COILS, TORCHES, &c.

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Drawings and Prices sent on application.

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CRICKMER'S Patent Metallic Pack-

ING for Steam-Engines, Pistons, Piston-Rod Stuffing-Boxes, Pumps, &c.—Notice is hereby given that a perpetual Injunction of the High Court of Chancery has been obtained by Messrs. CASTLER and PALMER, trading under the Firm of ALEX. ROSS and CO., Grange Mills, Bermondsey, against Messrs. LITTLE and CHAMBERS, of Manchester, to restrain them from further infringing the above Patent; and that the above Packing can only be obtained of Messrs. ALEX. ROSS and CO., Grange Mills, Bermondsey, LONDON (the Proprietors of the Patent), or by their authorised Agents.

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by which any number of Retorts, up to Twenty, can be heated by one Coke and one Tar Fire, reducing the fuel account in many instances to one-half of what it now is, and without the production of any smoke.

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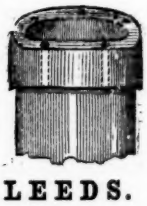

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